Reading from paper versus reading from screen in EFL

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Summary

This paper provides a detailed overview of literature concerning the reading process, reading as a skill and reading in English as a foreign language followed by a chronological survey of relevant literature on the subject. The aim of this study was to determine whether there is a difference in comprehension after reading a text on screen and on paper and to investigate the participants' habits and preferences of reading, reading in English and reading from screen. On a sample of 180 elementary school and high school students connections were drawn, and it was concluded that there is no statistically significant difference in the mean values of the comprehension test results between reading on paper and reading on screen. It was also concluded that computers and technology in general should be used in class as a means of adapting teaching to the students' needs, motivating them and making their spare time more productive.

Sažetak

Ovaj rad daje detaljni pregled literature koja se tiče procesa čitanja, čitanja kao vještine i čitanja na engleskom kao stranom jeziku te kronološki pregled relevantne literature o tim temama. Cilj ovog istraživanja bio je utvrditi postoji li razlika u razumijevanju teksta kada se čita s papira i kada se čita s ekrana te istražiti navike i izbore koje učenici prave pri čitanju, čitanju na engleskom jeziku i čitanju sa ekrana. Na uzorku od 180 učenika osnovne i srednje škole, zaključeno je da nema statistički značajne razlike u srednjim vrijednostima rezultata testa razumijevanja između čitanja s papira i čitanja s ekrana. Također je zaključeno da se računala i tehnologija općenito trebaju koristiti u nastavi kao sredstvo prilagodbe učeničkim potrebama koje će ih motivirati i učiniti njihovo slobodno vrijeme produktivnijim.

Key words

reading, reading comprehension, reading from paper, reading from screen, EFL

Ključne riječi

čitanje, čitanje s razumijevanjem, čitanje s papira, čitanje s ekrana, engleski kao strani jezik

Contents

1. Introduction

The reading process has been a focus of much debate during the second half of the last century. It was defined in different ways, from being simply the decoding of letters to including comprehension and interpretation into the definition of the reading process. However, one thing was evident, as Grabe (as cited in Celce-Murcia, 2001) stated, reading is probably the most important skill for second language learners in academic contexts. In teaching English as a foreign language, reading, as one of the basic four skills, must be developed along with vocabulary and grammar knowledge, and while it has been suggested that the new technologies will increasingly usurp the place of reading, this study will deal with whether this development can be done using these technologies.

More clearly, this paper will deal with the reading process itself and the different views of reading. It will also provide a survey of recent, relevant research on the subject matter and discuss its future prospects.

Practically, this study deals with whether there is a difference in comprehension after reading from screen and reading from paper. It also investigates the participants' habits and preferences of reading in general, reading in English and reading from a computer screen. The connections between these various variables will be drawn in order to gain insight into this topic from the students' point of view.

2. Theoretical overview of the reading process

2.1. The definition of reading

Dallman et al. (1978) define reading by comparing and contrasting various definitions of reading, from the most concise and narrow one, which defines reading as getting meaning from certain combinations of letters, and if you teach learners what each letter stands for, they will be able to read (Flesch, as cited in Dallman et al., 1978), to defining reading as more than word recognition. The authors further explain the following: without comprehension there is no reading, in reading the reader reacts to what is recorded in writing and this reaction is to some extent determined by the reader's background knowledge which can sometimes be of critical importance.

Grabe and Stoller (2002) define reading as the ability to draw meaning from a text and form an interpretation of that information, but emphasize that this definition is inadequate as a way to comprehend the true nature of reading abilities[1] because of four reasons: this single-sentence definition does not suggest the idea that there are a number of ways to engage in reading, depending on the reader's possible purposes of reading. Each purpose requires a different combination of employed skills[2] and strategies[3]. The second reason, according to Grabe and Stoller (2002), is that this definition does not reveal the many criteria that define a fluent reader and does not disclose the many skills, processes[4] and bases of knowledge that are combined to create the overall reading comprehension abilities that one commonly thinks of as reading. The third reason the former definition is inadequate is that it does not describe how reading is carried out as a cognitive process, which operates under intense time constraints and that is essential to understanding how reading comprehension works for the fluent reader. The last reason is that the given definition does not emphasize how the ability to draw meaning from a text and interpret it varies together with the second language (L2) proficiency of the reader.

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[1] Grabe and Stoller (2002) use this term to refer to what readers do while reading.
[2] Grabe and Stoller (2002) define skills as linguistic processing abilities that are relatively automatic in their use and their combinations, e.g. word recognition, syntactic processing etc. They are general learning outcomes of goal-driven tasks, acquired gradually and eventually automatised (Anderson; Proctor and Dutta; Schunk as cited in Grabe and Stoller, 2002).
[3] Strategies are defined as a set of abilities under conscious control of the reader, although many strategies are found to be automatic (which is the attribute of skills) therefore the boundary between skills and strategies is not entirely clear (Grabe and Stoller, 2002).
[4] Grabe and Stoller (2002) use this term to refer to mental operation that are in progress while reading.

Goodman (as cited in Mackay et al., 1979) defines reading as a psycholinguistic process by which the reader reconstructs, as best as s/he can, a message which has been encoded by a writer as a graphic display. Similarly, Prica-Soretić (1983) defines reading as a complex psycholinguistic processing of language input with the help of structural and semantic dimensions and interpretation of information according to individually preset norms.

Harmer (2003) discusses reading as a skill under the notion of receptive skills. He defines receptive skills as ways in which people extract meaning from the discourse they see or hear. While stating that there are some similarities about this kind of processing which can apply to both receptive skills, reading and listening, Harmer (2003) emphasizes that there are also considerable differences between the listening process and the reading process. Another author, Nunan (1999) also compares reading to listening by stating that both of these skills have been viewed as passive skills. The author goes on to explain that reading is, like listening, anything but passive as it involves processing ideas generated by others that are transmitted through language and highly complex cognitive processes. Like Harmer (2003), Nunan (1999) also emphasizes the major difference between these two skills, and that is that listening is ephemeral, and in reading, the written word is permanent.

Bernhardt (as cited in Ediger, 2001) defines reading as an interactive, sociocognitive process involving a text, a reader and a social context within which reading takes place. Similarly, Hudelson (as cited in Ediger, 2001) views reading as a construction of meaning through a transaction with the written text which involves interpretation of the text that is influenced by the reader's past experiences, language background, cultural framework and the reader's purpose for reading.

2.2. Purposes for reading

Grabe and Stoller (2002) explain seven different purposes for reading i.e. the quick, unconscious initial decisions one makes when beginning to read. These are: reading to search for simple information, reading to skim quickly, reading to learn from texts, reading to integrate information, reading to write (or search for information needed for writing), reading to critique texts and reading for general comprehension. Grabe and Stoller (2002) note that some researchers see reading to search for simple information as a relatively independent cognitive process, and that since it is very often used in reading tasks, it is best seen as a type of reading ability. Here, the reader scans the text for a specific piece of information or a specific word.

Reading to skim quickly means sampling segments of the text for a general understanding. Grabe and Stoller (2002) emphasize that this is a useful skill in its own right and that it is a combination of strategies for guessing where important information might be in the text and then using basic reading comprehension skills to form a general idea. Reading to learn form texts is a purpose that occurs in professional and academic contexts, where a person needs to learn a substantial amount of information from a text. Reading to learn is slower as far as the reading rate is concerned because of the rereading and reflecting which help the reader remember information; the reader also needs to connect text information with background knowledge, e.g. connect possible causes to a known event. Reading to integrate information requires critical evaluation of the information being read so that the reader can decide what information to integrate and how to integrate it for the reader's goal, thus reading to write and reading to critique texts are both variants of reading to integrate information because they both require abilities to compose, select and critique information from a text.

The last purpose for reading, according to Grabe and Stoller (2002), is reading for general comprehension. This is the most basic purpose for reading which supports most of the others purposes of reading. It is more complex than it is commonly assumed. When accomplished by a skilled fluent reader, reading for general comprehension requires very rapid and automatic processing of words, skilled forming of meaning and efficient coordination of many processes under extreme time limits. Fluent readers take these abilities for granted in their first language (L1), however, in L2 contexts the problems learners have in becoming fluent readers disclose the complexities of reading for general comprehension.

Davies (as cited in Nunan, 1999) names the following purposes for reading: receptive reading which is rapid, automatic reading we do when we read narratives; reflective reading, in which the reader often pauses and reflects upon what is read; skim reading i.e. rapid reading to see what the text is generally about and scanning or searching for specific information. The author also notes that the boundaries between these different types are vague.

Dallman et al. (1978) argue that the reader must approach the printed page with anticipation, with questions and with specific intent because only in that way will s/he get real meaning from what they read. They call this principle of reading with a purpose active reading.

Harmer (2003) names two broad categories of reasons for reading, and these are instrumental, which he explains as reading that helps us to achieve some clear goal, e.g. reading an instruction manual in order to understand how something works and pleasurable, explained as reading that takes place mostly for pleasure, e.g. reading novels, comics, magazines etc. The boundaries between the two categories are not fixed, so there are many crossovers between the

categories, as an example Harmer (2003) gives going to history lectures which students attend in order to pass an exam and graduate from college, but can also enjoy the lectures if they like the subject matter.

Dallman et al. (1978) also gives a similar classification: desire to read because of a need for information and desire to read in order to spend a pleasant leisure hour. Authors also claim that the desire to read comes from a sense of a need for reading which can be cultivated by creating necessary conditions. The desire to read becomes a purpose for reading.

Prica-Soretić (1983) defines skimming and scanning as the two types of fast reading. The author emphasizes that by using these methods readers sacrifice a large portion of understanding in order to quickly get the information they need.

2.3. Defining reading comprehension

Alderson (as cited in Grabe and Stoller, 2002) defines comprehension as the second component of reading (next to decoding or word recognition). In his view, comprehension consists of parsing[5] sentences, understanding sentences in discourse, building a discourse structure and than integrating this understanding with the reader's background knowledge. According to Grabe and Stoller (2002), reading for general comprehension is the ability to understand information in a text and interpret it appropriately. However, they emphasize that in order to fully understand reading comprehension one must define it according to a set of necessary processes that put together provide a more accurate account of the processes required for fluent reading.

Therefore, fluent reading is a rapid process in a sense that the more rapidly a text is successfully read, the better the various processing components are likely to operate; an efficient process in which various processes involved in comprehension must be coordinated and certain processes need to be carried out automatically and an interactive process because the various processes involved in comprehension are carried our simultaneously: one recognizes words very rapidly, keeping them active in our working memories, analyzes the structure of sentences and generates the most logical clause-level meanings, creates a model of the main idea of text comprehension in one's head, monitors comprehension etc. It is an interactive process also because the linguistic information from the text interacts with information activated by the reader as background knowledge. Fluent reading is also a strategic process in which the reader needs to

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[5]

recognize processing difficulties, pay attention to discrepancies between text information and reader knowledge and make decisions for monitoring comprehension and shifting goals for reading; a flexible process because the reader needs to be flexible in line with the changing purposes and the continuous monitoring of comprehension; an evaluating process i.e. the reader must decide if the information that is read is coherent and goes in line with the reader's purpose for reading. This is also connected to the reader's motivation, attitudes[6], feelings[7] and expectations toward the reading material. Further, fluent reading is a purposeful process (reading is always purposeful and motivated either internally or externally); a comprehending process because the reader's understanding of the text is the purpose for reading; a learning process since the most common way of learning, especially in academic contexts, is through reading and a linguistic process because if one does not understand the language, there is no comprehension.

Nunan (1999) defines reading comprehension as an interactive process between the reader and the text: the reader is required to fit the clues provided in the text to his/her own background knowledge. Goodman (as cited in Prica-Soretić, 1983) emphasizes that comprehension is the sole goal of reading, and Smith (as cited in Prica-Soretić, 1983) states that comprehension comprises of the addition of new experiences to old ones.

2.4. Reading processes

Dallman et al. (1978) suggest that the interpretation of written symbols yields meaning. They go on to explain that by studying eye movements while reading, important conclusions were drawn about the reading process. Authors first argue that the eyes of a fluent reader move across the line of writing in a series of rhythmical leaps or saccadic movements. They consist of the stops that the eyes make which are called fixations, and of movements between fixations that are called interfixation movements. Reading consists of about 90% fixations and about 10% interfixation movements. The part of the line where a reader fixates is called the perception span and a movement backward that a reader makes from a point of fixation to one previously read is labelled a regression. An efficient reader is the one who has more rhythmical saccadic movements, makes fewer fixations per line, makes fewer aimless regressions and has more

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[6] Devine (as cited in Nunan 1999) conducted a research about how attitudes about the reading process effect reading performance and concluded that the readers who defined good reading as meaning-centred outperformed their own competence predicted by proficiency tests. Those who were more sound- and word-centred failed to understand and recall what they had read.

[7] Prica-Soretić (1983) also states that the learner's affective side has a great influence on his/her cognitive abilities and vice versa.

accurate return sweep. Prica-Soretić (1983) also dealt with eye movements. She distinguished a good reader from a bad one according to the duration of pauses between fixations: a good reader makes fewer fixations per line and according to the time a reader spends on one fixation: a good reader spends less time on one fixation than a poor reader.

2.4.1. Lower-level reading processes

Grabe and Stoller (2002) divide reading processes into two groups: lower-level processes and higher-level processes. Lower-level processes are those that are more automatic linguistic processes and are seen as being more skills oriented. There are four lower-level processes according to Grabe and Stoller (2002). The first one is called lexical access, i.e. the calling up of the meaning of a word as it is recognized. Fluent readers can recognize almost all the words they encounter in their L1 at the rate of four to five words per second. Therefore, lexical access is very fast and automatic i.e. it cannot be readily reflected on consciously and it cannot be suppressed. Dallman et al. (1978) also deal with word recognition under the notion of aspects of reading. They state that word recognition is decoding of the printed page i.e. recognizing the oral equivalent of the written symbol, or discovering the correspondence between graphemes and phonemes.

Syntactic parsing is the second lower-level process according to Grabe and Stoller (2002), and is defined as taking in and storing words together so that basic grammatical information can be extracted. This ability allows readers to recognize phrasal groupings, word ordering information and subordinate and superordinate relations quickly in order to clarify how words are supposed to be understood. Syntactic parsing also helps disambiguate polysemous words out of context. Much like lexical access, syntactic parsing is also done very rapidly and is automatic. This automaticity is obvious in L1 settings where although readers read fluently, they encounter difficulties when asked to complete a grammar exercise at a conscious level. In L2 settings automatic and rapid syntactic parsing is less obvious because learners have explicit knowledge of grammatical structures before they become fluent L2 readers. Grabe and Stoller (2002) also state that what L2 readers need in order to develop this automaticity they already have in their L1 is exposure to print, and countless hours of it, which is almost impossible to provide in their L2.

Grabe and Stoller's (2002) third lower-level reading process is semantic proposition formation i.e. the process of combining word meanings and structural information into basic

clause-level meaning units. In other words, words that are recognized and kept active for one to two seconds, along with grammatical cueing, give the fluent reader time to integrate information in a way that makes sense in relation to what has been read before. Semantic proposition formation is also automatic and not easily controllable in any conscious way. Only in situations when some aspect of comprehension does not work properly, or the meaning does not seem to fit, a reader pauses to consider how to extract the most appropriate meaning from the reading text thus making the process more conscious.

When these three processes are functioning well, they effortlessly work together in the working memory. Working memory, according to Grabe and Stoller (2002), can be defined as a network of information and related processes that are being used at a given moment. They claim that the component that combines the previous three reading processes is the activation of the working memory. The accessed words, the information that is cued grammatically and the emerging meaning are all active for a short period of time in the working memory. In order to form an accurate sense of meaning, they need to be integrated and the information needs to be combined rapidly. Information is active in the working memory for one or two seconds while the appropriate processes are being carried out, therefore speed is essential. If the processing is not done rapidly, the information fades form the memory and must be reactivated and this makes reading inefficient and takes more resources.

Ediger (2001) names six processes of reading, two out of which could be placed under Grabe and Stoller's (2002) 'lower-level processes'. These are automatic recognition skills, which are here also described as unconscious abilities requiring little mental processing and vocabulary and structural knowledge i.e. a good understanding of language structure and a large recognition vocabulary.

2.4.2. Higher-level reading processes

According to Grabe and Stoller (2002), higher-level processes represent comprehension processes that make much more use of the reader's background knowledge and inferencing skills. In other words, they represent what we think of as reading comprehension. Their first higher-level reading process, and the most fundamental one, is the text model of reading comprehension. They elaborate that this is the coordination of ideas from a text that represent the main points and supporting ideas to form a meaning representation of a text. The main points become those ideas that are used repeatedly and that form usable linkages to other information.

Dallman et al. (1978) call comprehension the second aspect of reading. To them it is an absolute necessity in reading.

Grabe and Stoller (2002) call their second higher-level process the situation model of reader interpretation. This is the reader's interpretation of the information from the text in terms of his/her own goals, feelings and background expectations. This interpretation is influenced by background knowledge, inferences, reader goals, reader motivation, task and text difficulty and reader attitudes. The authors claim that the developing situation model of reader interpretation is the likely goal for reading comprehension. This is how a reader can understand both what the author is trying to say (text model) and provide e.g. a summary of the given text, and how the reader can interpret information from a text for his/her own purposes (situation model) and provide e.g. a critique of the given text.

The third higher-level reading process, according to Grabe and Stoller (2002) is background knowledge use and inferencing. Their relevance had already been described in the explanations of the previous two processes. Authors also state that as the reader goes from lower-level processes to the text model of reading comprehension and further on to the situation model of reader interpretation, background knowledge and inferencing take on greater and greater importance. Dallman et al. (1978) also argue that the reader's prior stock of impressions will in large determine how much meaning s/he will derive from the visual symbols s/he sees. Dallman et al. (1978) state that many authors do not consider word recognition and comprehension to be the only two reading processes. Gray (as cited in Dallman et al., 1978) also names reaction of the reader to what s/he has read and fusion i.e. incorporation of ideas gained through reading with the reader's past experiences. Russell (as cited in Dallman et al., 1978) also adds utilization stating that unless reading is used for a purpose, the act of reading has not been completed. Therefore, Dallman et al. (1978) argues that it is evident that reflection is the final aspect of reading. During the process of reading it is important to be able to hold ideas as they occur and conceptualize meaningful interpretation through reflection i.e. compare what is written with the reader's experiences and background knowledge. Nunan (1999) also states that the readers interpret what they read in terms of what they already know, and integrate what they already know with the content of what they are reading.

The first two higher-level reading processes, according to Grabe and Stoller (2002), text-model and situation-model construction, require abilities to monitor comprehension, use strategies as needed, re-evaluate and re-establish goals and repair comprehension problems. Grabe and Stoller (2002) call it executive control processing, and this is the final higher-level reading process. This is the way in which we evaluate our comprehension of a text.

Ediger (2001) names four more reading processes that could be classified under Grabe and Stoller's (2002) higher-level processes. These are formal discourse structure knowledge, which is an understanding of how texts are organized and how information is put together into various genres; content/world background knowledge which is consistent with Grabe and Stoller's (2002) background knowledge use and inferencing process; synthesis and evaluation skills/strategies, and these are reading and comparing information from various sources, thinking critically about what is read and separating the relevant and useful from the irrelevant and not useful, which Grabe and Stoller (2002) call   situation model of reader interpretation and metacognitive knowledge and skills monitoring, i.e. an awareness of one's mental processes and the ability to reflect on what one is doing, which strategies are employed etc. This process could be connected with Grabe and Stoller's (2002) executive control processing.

Grabe and Stoller (2002) claim that when it comes to reading in a L2, difficulties may arise due to inadequate background information, lack of necessary linguistic resources or not enough exposure to print. Readers try to overcome their comprehension difficulties by trying to understand the text through a slow mechanical translation process, however in this case lower-level processes in the working memory cannot operate well. They also try to overcome the difficulties by making an effort to form a situation model from past experiences and trying to force the text to fit those notions because if inappropriate background information is activated, comprehension is poor. Grabe and Stoller (2002) claim that using these two inefficient strategies leads to a loss of motivation for reading, and that in order to become fluent readers in a L2, readers need to spend many hours reading and solving texts and tasks that are appropriate to their abilities. Ediger (2001) also argues that in order for readers to read fluently in their L2, they must develop the ability to utilize all these processes described above simultaneously and rapidly. As far as the linguistic or cultural knowledge gaps are concerned, Ediger (2001) claims that it is the task of an effective reading program to provide information and practice in all the spheres that make the reading process efficient.

In the end, Grabe and Stoller (2002) emphasize that along with these individual processes, one must also not ignore the relevance of social factors on reading development (such as family literacy habits, primary schooling, and peer interaction), purpose or processes of reading.

2.5. Models of reading

2.5.1. Metaphorical models of reading

Grabe and Stoller (2002) claim that the notion 'models of reading' is an attempt by researchers to create a general understanding of the reading comprehension process. These models provide a metaphorical interpretation of the processes involved in reading comprehension. They argue that bottom-up models, top-down models and interactive models can be put under the heading 'metaphorical models of reading'. Harmer (2003) also explains the distinction between bottom-up and top-down processing. Bottom-up processing is when the reader focuses on individual words and phrases and understands the text by connecting these elements together out of which the reader creates a whole. Although criticizing this model stating that recent research advances proved this view not to be entirely accurate, Grabe and Stoller (2002) also state that there are aspects of this model that reflect lower-level processes of reading (word recognition and syntactic parsing). Nunan (1999) also criticizes this model because of its de-emphasis of meaning in the reading process. Using a technique called miscue analysis[8] researchers (Goodman and Burke, as cited in Nunan, 1999) found that reading is more that just a mechanical process of decoding, as the readers who were reading generated errors that made sense semantically.

In contrast to bottom-up processing, Harmer (2003) states that in top-down processing the reader gets a general view of the reading passage by absorbing the general picture by using his/her schemata[9] which helps them to have appropriate expectations of what they are about to read. Grabe and Stoller (2002) argue that this view is general and metaphorical because of the following paradox: What could a reader learn form a text if the reader must first have expectations about all the information in the text? They also claim that few reading researchers support strong top-down views.

Harmer (2003) emphasizes that one should see reading as an interaction between top-down and bottom-up processing because in some cases details enable us to understand the whole, and in other cases our overall understanding helps us process the details. Grabe and Stoller

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[8] Nunan (1999) explains it as the analysis of errors made by the reader when reading aloud.

[9] In order to understand a listening or reading text, we employ a 'pre-existent knowledge of the world' (Cook as cited in Harmer, 2003) and this suggests that the process of comprehension involves much more than just knowing the language. This necessary knowledge is also called a schema, i.e. a mental representation of typical situations we come across. Words, discourse patterns or contexts in a listening or a reading text stimulate us, this activates our schema and we are therefore able to understand what we read or hear because it fits into already known patterns. (Harmer, 2003)

(2002) call this interaction between top-down and bottom-up processing the interactive model. They claim that this is a self-contradictory model because the key processing aspects of the bottom-up model (efficiently coordinated automatic processing in working memory) are incompatible with strong top-down controls on reading comprehension. This is because the automatic processing aspects of comprehension need to be able to operate without a lot of interference from the constant information coming from background knowledge or inferencing. Therefore, Grabe and Stoller (2002) suggest a 'modified interactive model' which emphasizes the number of automatic processes carried out primarily in a bottom-up manner with little interference from other processing levels or background knowledge. Authors also argue that the varying purposes of reading may create complications in accepting this model (e.g. skimming a text for the main idea is a top-down process). Nunan (1999) also argues that reading is an interactive process in which the reader is constantly shifting from top-down to bottom-up processes.

2.5.2. The psycholinguistic guessing game model of reading

Goodman (as cited in Mackay et al., 1979) argues that the reader does not process a text by identifying and interpreting every single letter and word sequence in a text. The reader actually looks at a sample of the text and predicts the meaning of a larger part of it from what he has sampled and from his prior knowledge of the subject matter. After that the reader looks at another part of the text to confirm his/her prediction. Therefore in Goodman's (as cited in Mackay et al., 1979) psychological guessing game model of reading an efficient reader is a reader who guesses correctly with minimal text sampling. Grabe and Stoller (2002) summarize this model into three stages: hypothesising, sampling and confirming. Mackay et al. (1979) claim that it is a cyclical process of sampling, predicting, testing and confirming. They explain that the reader makes use of the redundancy in language which enables the reader to reconstruct the whole by extracting only a part of the graphic material i.e. the reader creates a replica of the text. After that, the reader tests the accuracy of his/her replica against previous information which is either information extracted from the text or background information. If the reader confirms that the replica corresponds to previous information, the cycle of sampling begins again.

Ediger (2001) also describes fluent readers in terms of this model, without actually verbalizing its name. The author writes about using semantic and syntactic information from the text and the reader's personal experience to from hypotheses. Then the author describes the

reader trying to confirm these hypotheses by sampling the text; if the hypotheses are confirmed the reader reads on, and of they are not the reader rereads the text or reformulates the hypotheses.

Mackay et al. (1979) further explain that some may suggest that any reader will have many potential points at which uncertainties may arise, however this is why Goodman (as cited in Mackay et al., 1979) called this model a 'psycholinguistic guessing game'. He claims that all readers sometimes guess wrong, and that one can differentiate good and poor readers by how quickly they recover from such wrong guesses. According to reading researches such as Gough and Wren (1999), Pressley (1998), Stanovich and Stanovich (1999) (as cited in Grabe and Stoller, 2002), this model of reading is considered to be fundamentally wrong because it is a classic example of a top-down approach to reading comprehension. Nunan (1999) also argues that the psycholinguistic model is top-down. Grabe and Stoller (2002) further claim that reading instruction based on this model has not been very beneficial for the learner's reading development. Their argument which repudiates this model is that good i.e. fluent readers typically do not guess what words will appear next in the text and that they also use context in fluent reading less often when contrasted with poor readers. The authors' second argument against this model is that reading abilities are not transferable across languages. They conclude that this model only accounts for an early stage of reading development.

On the other hand, Prica-Soretić (1983) calls attention to the fact that the results psycholinguistic research has provided had a great influence on the change of attitude toward the process of reading, which was no longer considered to be only a process of decoding.

2.5.3. Other models of reading

Stanovich (as cited in Grabe and Stoller, 2002) argues that the interactive compensatory model of reading is still relevant. There are four main theses of this model, and these are: readers develop efficient reading processes, less automatic processes interact regularly, automatic processes operate relatively independently, reading difficulties lead to increased interaction and compensation, even with processes that would otherwise be automatic.

Next, according to Grabe and Stoller (2002), there are word recognition models. They analyze only lower-level reading processes and are bottom-up in orientation. Word recognition models have in recent years also been known as connectionist theories of how the mind organizes information and learns from exposure to text and this model accounts for a considerable amount of what is known about word recognition processes under time constraints.

Hoover and Gough (as cited in Grabe and Stoller, 2002), claim that reading comprehension is composed of a combination of word recognition abilities and general comprehension abilities. In other words, when a decoding-skill measure and a comprehension skill measure (both in percentage scores) are multiplied, the result is a measure of reading comprehension. This view is called the simple view of reading model and is compatible with the interactive compensatory model.

2.6. The language threshold hypothesis

The language threshold hypothesis claims that learners must have sufficient L2 knowledge of vocabulary, grammar and discourse to make efficient use of skills and strategies that are part of their L1 reading comprehension abilities (Grabe and Stoller, 2002). It focuses on the relative importance of L2 knowledge in contrast with L1 reading abilities. This hypothesis states that L2 knowledge is more important that L1 reading abilities up to a certain point at which the learner has enough L2 knowledge to make use of skills and strategies that will help him/her read fluently. According to Grabe and Stoller (2002), a number of studies have shown a greater importance of L2 knowledge for readers in varying contexts. The authors also state that the critics of this hypothesis claim that its fault is that one cannot define one single set of linguistic knowledge as the threshold, but they also argue that this is not a strong criticism because reading fluency is influenced by a number of different factors (e.g. unknown topic, poor organisation, not enough time to read etc.). Grabe and Stoller (2002) explain that the idea behind the language threshold is not a fixed set of L2 knowledge, but a variable amount of language knowledge, combined with fluency of processing that is needed to read a particular text, on a particular topic, for a particular task. Therefore, readers can reach the threshold temporarily for a specific kind of text, but a new and difficult text can set them back a level. Authors argue that when readers exceed the linguistic threshold, they free up cognitive resources that are no longer occupied with trying to understand vocabulary and grammar, and can use reading skills and strategies from their L1 in the L2 setting. The applicable argument of this hypothesis is that L2 learners need to be exposed to a lot of reading, and focus on fluency and texts that are not too difficult for them (*i+1*). Nunan (1999) also deals with this hypothesis and states that L1 reading skills do not predict L2 reading fluency.

2.7. Chronological survey of research findings

Since this paper deals with reading on screen, which is undoubtedly related to technology, the year a related research has been published has a great significance, especially if one takes into account just how much technology has developed in the past decade, let alone two, or three decades. Therefore, the survey of related studies will be considered chronologically so as to demonstrate more clearly the shifts in the notion of 'screen' throughout the last three decades.

2.7.1. The 1980s

Marshall Pederson (1986) argues that the option of making a reading passage available while readers are answering comprehension check questions is of particular interest in this study. This option is known as passage availability. Marshall Pederson (1986) emphasizes this advantage of screen versus paper, seeing as computers can be programmed to remove the reading text while questions are being answered, and on the other hand, when reading from paper, learners need not always refrain from looking at the text for help in answering questions. The author also emphasizes other factors that have an impact on the comprehension process, like characteristics of questions that should induce attention to meaning rather than decoding because this improves comprehension and characteristics of readers (general verbal ability). The sample of this study consisted of eight class sections of fourth quarter French students at Ohio State University. They were placed in high- or low-verbal ability according to their GPA and most recent final grade in French. Questions also had two levels: low-level questions that required of the reader to recall individual words from the reading passage; and high-level questions that required of the reader to integrate the ideas of at least two separate clues in the passage. Results of the author's research show that passage unavailability during questioning leads to higher comprehension than passage availability. The results also indicated that the passage unavailable treatment always resulted in comparatively higher comprehension rate than in passage available treatments regardless of the other two variables, question level and verbal ability.

Dillon et al. (1988) reviewed literature on reading from VDUs (visual display units) focusing on the nature and causes of differences between reading from paper and screen. The authors name five observed differences in reading from paper and from screen: speed, accuracy, fatigue, comprehension and preference. As far as speed is concerned Dillon et al. name authors (Muter, et al., Gould and Grischkowsky etc. as cited in Dillon et al., 1988) that found a

performance deficit of between 20% and 30% when reading from screen. However, Dillon et al. (1988) argue that although they had similar findings, it is not clear whether the same mechanisms were responsible for the slower speed because of the big differences in procedure (e.g. Muter et al (as cited in Dillon et al., 1988) used white text on blue background, with the participants 2,5 meters from the screen; Gould and Grischkowsky (as cited in Dillon et al., 1988) used greenish texts on a dark background, with the participants sitting at any distance from the screen). In contrast, Dillon et al. (1988) also names studies in which reading speed was unaffected by the medium of reading (Askwall (as cited in Dillon et al., 1988) attributes this difference to the fact that her texts were relatively short, of about 22 sentences, without describing the details about the colour of the screen.). Similar problems occur in concluding whether there is an effect on the other four observed differences: definite conclusions cannot be drawn because of the variety of methodologies, procedures and materials used in the studies. Therefore, Dillon et al. (1988) conclude that reading speeds are reduced on typical VDUs and that accuracy is lessened for cognitively demanding tasks. Fatigue and comprehension seem to be unaffected by the reading medium, and as far as reader preference is concerned, hard copy is preferred to screen displays.

Authors also named possible causes of difference between reading from paper and reading from screen. Those might be orientation, because paper can be picked up and oriented to suit the reader, and VDUs are always vertical; eye movements: Mills and Weldon (as cited in Dillon et al., 1988) claim that measures of eye movements reflect difficulty, discriminability and comprehensibility of a text; visual angle: Gould et al. (as cited in Dillon et al., 1988) tried to prove that since line lengths on VDUs were usually longer, and that people compensate for this by sitting further away from the VDU while reading; aspect ratio i.e. relationship of width to height: paper sizes are higher that they are wide, and vice versa with VDUs; dynamics or screen filling and rate and direction of scrolled text; flicker because characters on VDUs are repeatedly fading and are being refreshed so they appear to flicker rather that remain constant; image polarity: Dillon et al. (1988) call dark characters on a light background positive presentation, and light characters on a dark background negative presentation; display characteristics (character size, line spacing and character spacing); anti-aliasing: authors claim that most computer displays are raster displays that contain dot matrix characters and lines because of which the edges of characters may appear rough. The process of anti-aliasing perceptually eliminates this phenomenon. The final possible cause of differences between reading from paper and reading from screen are user characteristics or experience of the participants with computers.

Research findings on all these possible causes of differences are inconclusive, i.e. there is no significant difference in reading from screen and reading from paper. The only possible cause that showed some significant results is image polarity: reading in positive presentation is faster than reading in negative presentation (Gould et al. as cited in Dillon et al., 1988). Gould et al. (as cited in Dillon et al., 1988) concludes that under the right conditions the differences between reading from the two media under discussion disappear. The researchers found that the slight differences that occurred were due to the fact that screen image did not resemble paper, therefore they conducted a study in which screen resembled paper, and concluded that the difference between these two media is more visual than cognitive and that the better image quality is, the more reading from screen resembles reading from paper and thus performance differences disappear. These findings suggest that the results of many earlier studies could be explained in terms of screen quality.

Dillon et al. (1988) draws the conclusion that although reading from screen is sometimes not as rapid or accurate as reading from paper, there is no single variable responsible for this difference. They further elaborate that with positive presentation, high screen resolution, refresh rate and anti-aliased characters in an appropriate font screen displays can resemble paper and aid reading. Since this review was published in 1988, the authors emphasize that the technology used in the above mentioned studies is of much better quality than the average computer and that until world wide screen standards improve, differences between reading from paper and reading from screen are likely to remain. The authors also emphasize that variables such as fatigue and reader preference should also be subjected to research in order to investigate just how big of an influence image quality actually has.

2.7.2. The 1990s

Dillon et al. (1990) conducted a research that explored reader performance and preference with a screen-presented journal article. The authors measured the effects of display size (20 and 60 lines) and sentence splitting on the reader's manipulation, comprehension and subjective impressions. Thirty two participants read a text on high resolution, black on white, A3 on a Hewlett-Packard VECTRA microcomputer. The design imitated the basic manipulation available to readers of printed texts, which made movement through the document easier. The participants first completed their task – writing a summary of the text they read and then filled in a questionnaire on matters such as difficulty of use of the display, what might be helpful to

facilitate its use, their own impressions of using it etc. There were four independent variables: small and large size of screen and split sentence and non-split sentence. Results of this experiment show there were no significant effects of the variables on comprehension. However, trends in the date suggest that levels of comprehension are visibly higher in the large window size for both split and non-split text. Three quarters of the readers who wanted to change the screen size were those reading from a small screen indicating that screen affects how readers interact with a text. The test also proved that splitting sentences across screens caused readers to return to the previous page twice as often as readers of the non-split text. Authors conclude that this subjective data reveals a preference for large screens and a high awareness of text format and that despite methodological issues concerning the measuring of comprehension, research on this topic must continue.

O'Hara and Sellen (1997) conducted a research that involved the task of summarizing an article. Five participants did the task of reading, taking notes and summarizing on paper, and another five participants did the same on screen (Apple Macintosh Quadra 950, Microsoft Word 6.0). The authors found three major differences between annotating on paper and on screen: annotations on paper were relatively effortless and integrated with reading, unlike annotations on screen which were awkward and distracted from the task. Further, annotations on paper were important, and those on screen did not have the same richness and variations as the ones on paper. The participants were reluctant to tamper with the text on the screen. Note-taking was also very different, as the one that took place on paper was frequent and interwoven with reading, and the one on screen was intercepted with long periods of editing.

Navigation through documents also proved to be important in both conditions for information organization, for reference and for checking comprehension. Navigation through paper was quick, and the one on screen was slow and distracting. Two-handed movement through paper overlapped navigation with other activities and the one on screen required breaking away from ongoing activities because it was not followed by immediate feedback and spatially constrained to active areas on the screen. The ability to see a complete page while reading on paper caused incidental memory for where things were which helped in completing the task.

Text layout was important for gaining an overall sense of the structure of the document and for integrating reading and writing. There were some differences between the two groups: laying out paper in space aided visualization which helped in quick references to other documents. On screen, the participants lost resolution through shrinking documents or overlapped windows. Paper aided the use of separate reading and writing spaces, and screen

allowed only one input to be accepted at a time so the participants had problems integrating reading and writing.

Researchers conclude that the benefits of paper far outweigh the benefits of on-line tools such as spell-checkers or word counts. However, unlike previously mentioned research, the advantages of paper versus screen are not evident solely in screen resolution or viewing angle, but in annotation while reading, quick navigation and flexibility of spatial layout. These allow readers to deepen their comprehension, extract its structure, consult other sources of information and infuse reading and writing. The authors suggest that technologies should look to paper for improvement in terms of recognizing that annotations are an integral part of reading and extremely important in implementing comprehension, supporting quicker i.e. more effortless navigation techniques and creating more flexibility and control in spatial layout.

2.7.3. The 2000s and future prospects

The author investigates the difficulties EFL learners come across while reading on the web. The flaws Tseng (2008) emphasizes are eyestrain, skipping lines and the inability to take notes and underline while reading. Barnes (as cited in Tseng, 2008) claims that the process if reading a hypertext is very much different from the process of reading a text on paper. While reading web pages readers encounter graphics, sounds, pictures, text, animation and video clips. The author also claims that while reading on the web readers read in scattered bits and pieces, and not as a whole. The eyes do not move linearly as while reading from paper, but in circular motion. Ojala (as cited in Tseng, 2008) states that online reading is not a linear activity. Tseng (2008) explains that the aim of this study was to find difficulties EFL learners experience and provide pedagogical suggestions accordingly. The participants (Thai) were asked to do reading comprehension exercises online and were then interviewed about the difficulties they came across. When asked to name the factors that influenced reading online, 50% of the participants complained about eyestrain and felt their eyes were blurred and could not read clearly. They further mentioned the inability to think while at the computer, the desire to browse other irrelevant web pages, background colour that was too bright and font size that was too small. They also argued that it was easier for them to skip lines while reading on screen.

When asked to name advantages of reading on the web, the participants said it was convenient for searching information and the many animated pictures. They named far more disadvantages such as too many words, eyes getting tired, inability to write anything on the

computer, inability to move the computer, inability to focus, the participants argued they were not used to reading on screen etc. In conclusion, Tseng (2008) provides pedagogical implications of this research, and these are the importance of selecting appropriate web pages for EFL learners which provide clear instructions and proper content, learners should be able to adjust the brightness, width, colour contrast and font size of the screen to their own liking, it is recommended that testing should be conducted on paper and finally, learners should be taught how to read text on the web i.e. courses should be provided on how to look for information online and how to read through it.

Graham (2009) argues that the current generation is very quickly becoming used to technology, where access to information (YouTube, Wikipedia, Facebook etc.) is quick, efficient and easily available. He repudiates the argument that supports reading from paper, which states that reading from screen is not sustainable because you cannot move it with you or write on it, stating that devices such as Amazon's Kindle and Apple's iPad Touch have changed that forever. Even newspaper is, in this author's opinion, being replaced with online editions or people downloading the news on their iPads and reading them on their way to work. Graham (2009) explains that even third-world countries will not be neglected in this area because the Internet is accessible via mobile phones which are the most numerous in the developing world.

3. Reading from screen versus reading from paper in EFL: study report

3.1. Aim

The aim of this study was to examine whether the medium of reading influences reading comprehension in English as a foreign language. The two media of reading under investigation are paper and screen (i.e. reading from paper and reading from a computer screen). The main purpose of this study was to compare the test results of a comprehension task after reading a text from paper and from screen. In addition, the goal was also to establish whether variables such as age, gender and grade in English play a role in the test results. The aim of this study was also to explore the habits and preferences of reading in general, reading in English and usage and reading from a computer screen. The connections between the learners' habits and preferences and test results were also compared.

3.2. Sample

Overall, there were 180 participants in this study. 116 of them were female, and 64 were male. As can be seen from Table 1, the learners come from four different schools: Bizovac Elementary School where the participants read from paper: elementary school – paper, Valpovo Elementary School where the participants read from screen: elementary school – screen and Grammar School Osijek where the participants read both from paper and from screen.

Table 1: Number of participants according to school and gender

school * gender Crosstabulation

Count

		gender		Total
		male	female	
school	Bizovac Elementary School	17	30	47
	Valpovo Elementary School	20	26	46
	Grammar School Osijek	27	60	87
Total		64	116	180

As visible from Table 2, 30.7% of the participants got the grade 4 (very good) in English at the end of the first semester of the current school year, 27.8% of them got the grade 3 (good); 27.4% got the highest grade 5 in English (excellent); 12.7% got the grade 2 (sufficient) and only 1.4% of the participants failed the first semester (grade 1 or insufficient).

Table 2: Frequencies and percentages of participants according to grade in English

grade in English

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,00	3	1,4	1,4	1,4
	2,00	27	12,6	12,7	14,2
	3,00	59	27,6	27,8	42,0
	4,00	65	30,4	30,7	72,6
	5,00	58	27,1	27,4	100,0
	Total	212	99,1	100,0	
Missing	System	2	,9		
Total		214	100,0		

3.3. Instruments

The text that was read in the two elementary schools is called "Two sisters and the cat"[10] and is written by Laurie Buchannan. The text was followed by eight multiple-choice questions (MCQ) that were considered to be appropriate and therefore used. The source also contained the key to the questions that were used when correcting the tests. The length of the text and the level of necessary vocabulary and grammar knowledge were thoroughly discussed with the learners' teachers prior to choosing the appropriate text. The text is 244 words long, divided into three paragraphs. The content of the text was left in its original, except for changing the word 'condominium' to 'flat' in both the text and the first question, because it was considered to be too unknown to the participants and that it would greatly influence the comprehension of the text. Question 3 was also changed from 'What did Mrs. Wilson do?' to 'What did Mrs. Wilson do to help her sister?' because it was considered to be too vague and unclear. The text was written in MS Word, 1.5 spacing, Times New Roman, font size 12[11]. The text occupied about one half of the page. The questions were on a separate MS Word document. Before reading the questions learners had to circle their gender and write down their final grade in English in their first semester of the current school year. This was written in Croatian. After that, on the same

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[10] Buchanan, L. *Two sisters and the cat.* Available at:
http://web2.uvcs.uvic.ca/elc/studyzone/200/reading/smicat1.htm (visited on 1st Apr 2011)
[11] Gould et al. (as cited in Dillon et al., 1988) also used screen layout which resembled printed paper.

page, came the eight questions. The questions all have three possible alternatives out of which only one is correct.

The text that was used with second graders of high school was from a textbook that specified in providing texts and comprehension MCQ (the book also contained key to the questions that were used while correcting the text)[12]. Again, the length of the text and the level of necessary vocabulary and grammar knowledge were thoroughly discussed with the learners' teachers prior to choosing the appropriate text. The text is 576 words long, divided into six paragraphs. The content of the text was left in its original, except for the fact that it had no title which was therefore provided ('Does it hurt?'). The text was written in MS Word, 1.5 spacing, Times New Roman, font size 12. The text occupied one full page. The questions were on a separate MS Word document. Before reading the questions learners had to circle their gender and write down their final grade in English in their first semester of the current school year. This was written in Croatian. After that, on the same page, came the eight questions. The multiple choice questions all have three options and only one correct answer. In the original, the questions contained only two alternatives, which was considered to be too simple for the participants, and therefore the third alternative was added corresponding to the text and the extent of the question. Also, the original contained ten questions, out of which two were dismissed and not included in the test in order for it to be comparable with the test used in elementary school. The questions were selected based on their difficulty, unambiguousness and comprehensibility. Questions number 2 and 6 (8 in the original) were altered because they were originally yes/no questions and were therefore changed into wh-questions (from *Does the writer of this piece think one can change one's pain threshold?* to *What does the author of this piece think about changing a person's pain threshold?* and from *Did the writer find that other people agreed with him about pain?* to *How did the author confirm his ideas about pain?*).

The final, third part of the instrument was a questionnaire in Croatian. The questionnaire comprised of 16 statements. The statements were followed by a five-point scale on which the learner had to mark his/her level of agreement with the statement (1 − I completely disagree; 2 − I disagree; 3 − I don't agree nor disagree; 4 − I partially agree; 5 − I completely agree). After these statements there were two open questions to which learners had to answer.

The appropriateness of MCQ was confirmed in literature. Munby (1968) states that multiple-choice questioning is objective and therefore the examiner does not have to decide on the accuracy of the answer. The author further claims that MCQ can be effectively used to train a

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[12] Hill, L.A. (1988) Further Stories for Reading Comprehension B. Longman.

person's ability to think and repudiates opinions that MCQ are too simple, explaining that the difficulty level depends on the distractors. Harmer (2003) also deals with the issues of choosing the right topic which, in his opinion, has to create interest and activate schemata.

3.4. Procedure

The participants were given the reading text, question and questionnaire during their regular English classes with the consent of their teachers. After introductions, detailed instructions about the procedure were given. The purpose of the study was not revealed. Their teacher was present during the process and did not interfere with the procedure. It was thought that the presence of the teacher would not influence the results as it was emphasized to the participants that the results of the study would not be disclosed to their teacher and therefore would not influence their final grade in any way. On the other hand, the participants were repeatedly warned not to consult their colleagues while answering comprehension check questions emphasizing that this would not help them in any way but would tamper with the results of the study. As the study was conducted on two separate media, the procedure differs depending on the media the participants were reading from.

3.4.1. Procedure for reading from screen

The same procedure was followed in both elementary and high school. In this scenario, prior to the testing, it was arranged with two teachers to have the class in the computer room of their school. Before the class began, the MS Word documents were copied to every computer in the classroom. The first document, entitled Part 1 consisted of the text only, the second document entitled Part 2 comprised of the questions and the third document, entitled Part 3 contained the questionnaire. When the participants came into the room they were instructed not to open any documents or do anything until instructed. It was explained to them that they were about to read a text from the computer screen and that they would later answer questions related to that text. It was also emphasized that no questions about the meaning of words or text etc. should be asked for they would not be answered. No further information was revealed. Then, they were instructed to open the MS Word document entitled Part 1 and read it. In high school they had 5 minutes and in elementary school 3 minutes for reading. The time limitation was set in a way that would not

allow them to read the text more than once, but would give them enough time to read it thoroughly. After reading the text, the participants were instructed to close the document and delete it from the computer. Blank sheets of paper were distributed to each participant. Next, they were instructed to open the second document, Part 2, and answer questions related to the text on the paper writing down their gender, final grade in English and the number of the question and the letter of the correct answer. It was stressed that only one answer in each question is correct and the participants were once again warned not to consult their colleagues while answering questions. Both the teacher and I monitored the class, making sure no foul play would happen. After the participants were done with the questions (they had 3 minutes to do it in both age groups) they were instructed to close that document and open the document named Part 3. After they had opened it, they were explained how to fill in this kind of a questionnaire, i.e. that the statements at hand pertain to them, what each number stood for, and they were given an example using the first statement. It was also stressed that at this time they could ask for an explanation if something is unclear and that they had to answer the last two open questions. They were told to write down only the number of the statement and the number of the extent to which that statement relates to them. These instructions were given in Croatian. After they were done, the papers were collocated and the participants were told to close this last document. It must also be noted that due to technical difficulties a small amount of the participants had to share a computer because the schools are not equipped with a suitable amount of computers (which would be one student per computer). In ESS there were three to four couples and in HSS there were five to six couples.

3.4.2. Procedure for reading from paper

The same procedure was followed in both elementary and high school. It was explained to the participants that they were about to read a text and that they would later answer questions related to that text. It was also emphasized that no questions about the meaning of words or text etc. should be asked for they would not be answered. No further information was revealed. Then, the first sheet of paper that contained the printed version of the text was distributed turned upside down and after all participants got it, they were instructed to turn it over and start reading. In high school they had 5 minutes and in elementary school 3 minutes for reading. As with the reading from screen group, the time limitation was set in a way that would not allow them to read the text more than once, but would give them enough time to read it thoroughly. After

reading, the papers with the text were collected and put away. Next, the second piece of paper that comprised of the questions and questionnaire stapled together (each on a separate piece of paper, put one behind another) was distributed, also upside down. The participants could start answering only when all of them got the papers. They were instructed to answer the questions related to the text circling their gender, writing down their final grade in English and circling the letter of the correct answer below each question. It was stressed that only one answer in each question was correct and the participants were once again warned not to consult with their colleagues while answering questions and not to turn the page i.e. look at the second paper before they were told to do so. Both the teacher and I monitored the class. After the participants were done with the questions (they had 3 minutes to do it in both age groups) they were instructed to turn the page and fill in the questionnaire. They were given the same explanation how to fill in the questionnaire as the reading from screen group. These instructions were given in Croatian. After they were done, the papers were collected and the participants were thanked for their cooperation. It must be noted that the participants were told to occupy all desks so that as little of them as possible sat in pairs. Up to six couples in every classroom sat in pairs, and the rest of the participants sat alone.

3.5. Results

3.5.1. Comprehension test results

The main purpose of this study was to explore whether there are any differences in text comprehension between reading from paper and reading from screen. As can be seen in Table 3, the descriptive statistics show that the participants reading from screen achieved a higher mean score (M=5.53, SD=1.70) in the comprehension test than the participants reading from paper (M=4.98, SD=2.27).

Table 3: Group statistics (reading medium)

Group Statistics

	reading medium	N	Mean	Std. Deviation	Std. Error Mean
reading test result	paper	90	4,9778	2,26838	,23911
	screen	90	5,5333	1,70393	,17961

To check whether this is statistically significant, an independent-samples t-test was conducted. As can be seen in Table 4, there was no statistically significant difference in scores for paper and screen t (165.182)=-1.86, p=.065[13].

Table 4: Independent samples t-test (reading medium)

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
										95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper	
reading test result	EVA[14]	6,238	,013	-1,858	178	,065	-,55556	,29905	-1,14570	,03459	
	EVNA[15]			-1,858	165,182	,065	-,55556	,29905	-1,14601	,03490	

Next, the differences in the test results between male and female participants of the study were explored. Table 5 shows the descriptive statistics for the two gender groups. It is visible that male participants achieved a higher mean score (M=5.36, SD=2.11) in the comprehension test than female participants (M=5.19, SD=1.97).

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[13] In the Levene's test for equality of variances Sig. value is less than .05 (p=.013) (the assumption of equal variances has been violated i.e. the variances for the two groups (paper and screen) are not the same) and therefore the information that is analyzed is from 'Equal variances not assumed' line.
[14] Equal variances assumed
[15] Equal variances not assumed

Table 5: Group statistics (gender)

Group Statistics

	gender	N	Mean	Std. Deviation	Std. Error Mean
reading test result	male	64	5,3594	2,11095	,26387
	female	116	5,1983	1,97471	,18335

To check whether this is statistically significant, an independent-samples t-test was conducted. As can be seen in Table 6, there was no statistically significant difference in scores for male and female participants t (178)=.511, p=.610)[16].

Table 6: Results for independent samples t-test (gender)

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
										95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper	
reading test result	EVA	,654	,420	,511	178	,610	,16110	,31515	-,46082	,78302	
	EVNA			,501	122,833	,617	,16110	,32131	-,47493	,79713	

Then, the differences in the test results between elementary school and high school participants were explored. As can be seen in Table 7, descriptive statistics for the two age groups show that high school participants achieved a higher mean score (M=5.72, SD=1.81) in the comprehension test than elementary school participants (M=4.82, SD=2.12).

Table 7: Group statistics (age)

Group Statistics

	age	N	Mean	Std. Deviation	Std. Error Mean
reading test result	elementary school (7th graders)	93	4,8172	2,11591	,21941
	high school (2nd graders)	87	5,7241	1,80883	,19393

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[16] In the Levene's test for equality of variances Sig. value is larger than .05 (p =.420) (the assumption of equal variances has not been violated i.e. the variances for the two groups (male and female) are the same) and therefore the information that is analyzed is from 'Equal variances assumed' line.

To check whether this is statistically significant, an independent-samples t-test was conducted. Table 8 shows there is a statistically significant difference in scores for elementary school and high school participants t (176.56)=-3.097, p=.002. The magnitude of differences in the means was small (eta squared=.0506). Expressed as a percentage, 5.06% of the variance in test results is explained by age differences.

Table 8: Results for independent samples t-test (age)

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
reading test result	EVA	4,794	,030	-3,081	178	,002	-,90693	,29436	-1,48782	-,32605
	EVNA			-3,097	176,595	,002	-,90693	,29283	-1,48483	-,32904

Then, the differences in the test results between elementary school participants reading from screen and high school participants reading from screen were explored. As can be seen in Table 9, descriptive statistics show that high school participants reading from screen achieved a higher mean score (M=6.23, SD=1.41) in the comprehension test than elementary school participants reading from screen (M=4.87, SD=1.71).

Table 9: Group statistics (age - reading from screen)

Group Statistics

	school	N	Mean	Std. Deviation	Std. Error Mean
reading from screen test result	elementary school – screen	46	4,8696	1,70761	,25177
	high school - screen	44	6,2273	1,41197	,21286

To check whether this is statistically significant, an independent-samples t-test was conducted. Table 10 shows that there is a statistically significant difference in scores for elementary school and high school participants reading from screen t (88)=-4.101, p=.000. The magnitude of

differences in the means was large (eta squared=.1605). Expressed as a percentage, 16.05% of the variance in test results after reading from screen is explained by age.

Table 10: Results for independent samples t-test (age - reading from screen)

Independent Samples Test

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | 95% Confidence Interval of the Difference | |
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
reading from screen test result	EVA	3,334	,071	-4,101	88	,000	-1,35771	,33109	-2,01568	-,69973
	EVNA			-4,118	86,221	,000	-1,35771	,32970	-2,01310	-,70231

After that, the differences in the test results between elementary school participants reading from paper and high school participants reading from paper were explored. As can be seen in Table 11, descriptive statistics show that high school participants reading from paper achieved a higher mean score (M=5.21, SD=2.03) in the comprehension test than elementary school participants reading from paper (M=4.77, SD=2.47).

Table 11: Group statistics (age - reading from paper)

Group Statistics

	school	N	Mean	Std. Deviation	Std. Error Mean
reading from paper test result	elementary school – paper	47	4,7660	2,46905	,36015
	high school - paper	43	5,2093	2,03023	,30961

To check whether this is statistically significant, an independent-samples t-test was conducted. Table 12 shows there is no statistically significant difference in scores for elementary school and high school participants reading from paper t (88)=-.925, p=.357.

Table 12: Results for independent samples t-test (age - reading from paper)

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
										95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
reading from paper test result	EVA	3,702	,058	-,925	88	,357	-,44334	,47908	-1,39541	,50872
	EVNA			-,933	87,045	,353	-,44334	,47493	-1,38732	,50063

Next, the differences in the test results in elementary school between reading from paper and reading from screen were explored. As can be seen in Table 13, descriptive statistics show that the elementary school participants reading from screen achieved a higher mean score (M=4.87, SD=1.71) in the comprehension test than the elementary school participants reading from paper (M=4.77, SD=2.47).

Table 13: Group statistics (medium - elementary schools)

Group Statistics

	reading medium	N	Mean	Std. Deviation	Std. Error Mean
reading test result – elementary schools	paper	47	4,7660	2,46905	,36015
	screen	46	4,8696	1,70761	,25177

To check whether this is statistically significant, an independent-samples t-test was conducted. As can be seen in Table 14, there was no statistically significant difference in scores for paper and screen t (81.942)=-.236, p=.814.

Table 14: Results for independent samples t-test (medium - elementary school)

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
										95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
reading test result	EVA	7,828	,006	-,235	91	,815	-,10361	,44112	-,97983	,77262
	EVNA			-,236	81,942	,814	-,10361	,43943	-,97778	,77056

Next, the differences in the test results in high school between reading from paper and reading from screen were explored As can be seen in Table 15, descriptive statistics show that the participants reading from screen achieved a higher mean score (M=6.23, SD=1.41) in the comprehension test than the participants reading from paper (M=5.21, SD=2.03).

Table 15: Group statistics (medium - high school)

Group Statistics

	reading medium	N	Mean	Std. Deviation	Std. Error Mean
reading test result – high school	paper	43	5,2093	2,03023	,30961
	screen	44	6,2273	1,41197	,21286

To check whether this is statistically significant, an independent-samples t-test was conducted. As can be seen in Table 16, there is a statistically significant difference in scores for paper and screen t (85)=-2.720, p=.008. The magnitude of differences in the means was moderate (eta squared=.0801). Expressed as a percentage, 8.01% of the variance in test results in high school is explained by different medium.

Table 16: Results for independent samples t-test (medium - high school)

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
reading test result	EVA	3,869	,052	-2,720	85	,008	-1,01797	,37420	-1,76199	-,27395
	EVNA			-2,709	74,772	,008	-1,01797	,37572	-1,76648	-,26946

Table 17 shows the relationship between the final grades the participants had in English in the first semester of the current school year and the comprehension test results which was investigated using Pearson product-moment correlation coefficient. There was a strong, positive correlation between the two variables (r=.609, n=178, p<.0001) with high comprehension test scores associated with high final grades in English. Therefore, the correlation indicated 37.08% of shared variance, or in other words the final grades help to explain nearly 37.08% of the variance in the participants' scores on the comprehension test.

Table 17: Correlation of final grades in English and test results

Correlations

		reading test result	grade in English
reading test result	Pearson Correlation	1	,609**
	Sig. (2-tailed)		,000
	N	180	178
grade in English	Pearson Correlation	,609**	1
	Sig. (2-tailed)	,000	
	N	178	178

**. Correlation is significant at the 0.01 level (2-tailed).

3.5.2. Questionnaire results

Descriptive statistics of the questionnaire the participants filled in is visible in Table 18. The highest level of agreement is with the 2nd statement (*I use my computer every day.)* M=4.62, SD=0.84. The lowest level of agreement is with the 14th statement (*I borrow books in English from the library.)* M=1.63, SD=1.04. Other interesting values are that of statement number 9 (*I understand printed texts better than texts on screen.)* which has a mean value of M=3.36, SD=1.18 while the 12th statement (*I understand texts on screen better than on paper.)* has a mean value of M=2.86, SD=1.19. Statement number 15 (*There's no difference between reading on screen and on paper.)* has a mean value of M=3.67, SD=1.33. The 5th statement (*My English teacher uses a computer in class often.*) has a mean value of only M=2.10, SD=1.03.

Table 18: Descriptive statistics, questionnaire

Descriptive Statistics

	N	Min	Max	Mean	Std. Deviation
2. I use my computer every day.	180	1,00	5,00	4,6222	,84003
3. I use my computer mostly for Facebook, MSN etc.	180	1,00	5,00	3,7389	1,25678
15. There is no difference between reading on screen and on paper.	180	1,00	5,00	3,6667	1,33287
4. I use my computer for school assignments.	179	1,00	5,00	3,6257	1,20840
11. I choose English as the language of the web page.	179	1,00	5,00	3,4413	1,55450
9. I understand printed texts better than texts on screen.	180	1,00	5,00	3,3611	1,18068
10. I often read in English from my computer.	180	1,00	5,00	3,3611	1,51257
1. I read for pleasure.	180	1,00	5,00	3,2056	1,40111
13. I read texts in English more often than in Croatian when I am at the computer.	180	1,00	5,00	3,0944	1,47870
16. I read English more often on screen than on paper	179	1,00	5,00	3,0726	1,48031
12. I understand texts on screen better than on paper.	177	1,00	5,00	2,8644	1,18883
6. I read books other that assigned book reports.	179	1,00	5,00	2,8156	1,62998
8. I read newspaper on the internet.	180	1,00	5,00	2,5667	1,54305

5. My English teacher uses a computer in class often.	180	1,00	5,00	2,1000	1,03081
7. I read e-books.	179	1,00	5,00	1,8156	1,24728
14. I borrow books in English from the library.	179	1,00	5,00	1,6313	1,03767
Valid N (listwise)	171				

Table 19 shows the relationship between the final grades the participants had in English in the first semester of the current school year, comprehension test results and questionnaire statements which was investigated using Pearson product-moment correlation coefficient. There was a small, positive correlation between the reading test result and 1st statement (r=.234, n=180, p<.0001, 5.58% of shared variance), the 5th statement (r=.256, n=180, p<.0001, 6.55% of shared variance), the 6th statement (r=.221, n=179, p<.0001, 4.88% of shared variance), the 14th statement (r=.261, n=179, p<.0001, 6.81% of shared variance), the 16th statement (r=.292, n=179, p<.0001, 8.53% of shared variance) and between the reading test result and the 15th statement (r=.177, n=180, p<.0005, 3.13% of shared variance). There was also a medium, positive correlation between the reading test result and the 13th statement (r=.398, n=180, p<.0001, 15.84% of shared variance) and between the reading test result and the 11th statement (r=.431, n=179, p<.0001, 18.58% of shared variance) and a large, positive correlation between the reading test result and the 10th statement (r=.504, n=180, p<.0001, 25.4% of shared variance).

Grade in English had a small, positive correlation with the 14th statement (r=.261, n=179, p<.0001, 6.81% of shared variance) and with the 15th statement (r=.164, n=178, p<.0005, 2.69% of shared variance) and a small, negative correlation with the 3rd statement (r=-.185, n=178, p<.0005, 3.42% of shared variance). There was also a medium, positive correlation between the grade in English and the 1st statement (r=.349, n=178, p<.0001, 12.18% of shared variance), the 4th statement (r=.250, n=177, p<.0001, 6.25% of shared variance), the 6th statement (r=.382, n=177, p<.0001, 14.59% of shared variance), the 13th statement (r=.496, n=178, p<.0001, 24.6% of shared variance) and the 16th statement (r=.328, n=177, p<.0001, 10.76% of shared variance). Grade in English also had a large, positive correlation with the 10th statement (r=.567, n=178, p<.0001, 32.15% of shared variance) and with the 11th statement (r=.575, n=177, p<.0001, 33.06% of shared variance).

Table 19: Correlations of reading test results, grades in English and questionnaire statements

Correlations

	reading test result	grade in English
1. I read for pleasure.	,234**	,349**
2. I use my computer every day.	,097	,097
3. I use my computer mostly for Facebook, MSN etc.	-,086	-,185*
4. I use my computer for school assignments.	,066	,250**
5. My English teacher uses a computer in class often.	,256**	,091
6. I read books other that assigned book reports.	,221**	,382**
7. I read e-books.	,093	,059
8. I read newspaper on the internet.	-,029	-,006
9. I understand printed texts better than texts on screen.	-,093	,038
10. I often read in English from my computer.	,054**	,567**
11. I choose English as the language of the web page.	,431**	,575**
12. I understand texts on screen better than on paper.	,083	,133
13. I read texts in English more often than in Croatian when I am at the computer.	,398**	,496**
14. I borrow books in English from the library.	,261**	,250**
15. There is no difference between reading on screen and on paper.	,177*	.164*
16. I read English more often on screen than on paper	,292**	,328**

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

The differences in the mean values of the statements in the questionnaire between elementary school and high school participants were explored. It can be seen from Table 20 that descriptive statistics show that high school participants have a higher mean value in the 1st statement (M=3.51, SD=1.36) than elementary school participants (M=2.92, SD=1.38), the 2nd statement (M=4.85, SD=0.54) than elementary school participants (M=4.41, SD=1.00), the 4th statement (M=3.89, SD=1.08), than elementary school participants (M=3.38, SD=1.27), the 5th statement (M=2.14, SD=1.04) than elementary school participants (M=2.06, SD=1.03), the 6th statement (M=3.33, SD=1.55) than elementary school participants (M=2.33, SD=1.56), the 7th statement (M=2.01, SD=1.34) than elementary school participants (M=1.63, SD=1.13), the 8th statement (M=2.97, SD=1.57) than elementary school participants (M=2.19, SD=1.43), the 10th statement (M=3.81, SD=1.29) than elementary school participants (M=2.95, SD=1.59), the 11th statement (M=3.76, SD=1.49) than elementary school participants (M=3.14, SD=1.57), the 13th statement (M=3.44, SD=1.48) than elementary school participants (M=2.77, SD=1.42), the 14th statement

(M=1.83, SD=1.19) than elementary school participants (M=1.45, SD=0.83) and the 16th statement (M=3.54, SD=1.43) than elementary school participants (M=2.63, SD=1.39). It is also visible from Table 28 that elementary school participants have a higher mean value in the 3rd statement (M=3.88, SD=1.32) than high school participants (M=3.59, SD=1.18), the 9th statement (M=3.39, SD=1.23) than high school participants (M=3.33, SD=1.13), the 12th statement (M=3.02, SD=1.34) than high school participants (M=2.69, SD=0.78) and the 15th statement (M=3.69, SD=1.33) than high school participants (M=3.62, SD=1.34).

Table 20: Group statistics (age), questionnaire

Group Statistics

	age	N	Mean	Std. Deviation	Std. Error Mean
1. I read for pleasure.	elementary school	93	2,9247	1,38499	,14362
	high school	87	3,5057	1,36291	,14612
2. I use my computer every day.	elementary school	93	4,4086	1,00257	,10396
	high school	87	4,8506	,53978	,05787
3. I use my computer mostly for Facebook, MSN etc.	elementary school	93	3,8817	1,31752	,13662
	high school	87	3,5862	1,17683	,12617
4. I use my computer for school assignments.	elementary school	92	3,3804	1,27393	,13282
	high school	87	3,8851	1,08290	,11610
5. My English teacher uses a computer in class often.	elementary school	93	2,0645	1,03005	,10681
	high school	87	2,1379	1,03623	,11110
6. I read books other that assigned book reports.	elementary school	92	2,3261	1,56267	,16292
	high school	87	3,3333	1,54519	,16566
7. I read e-books.	elementary school	92	1,6304	1,12628	,11742
	high school	87	2,0115	1,34246	,14393
8. I read newspaper on the internet.	elementary school	93	2,1935	1,43146	,14844
	high school	87	2,9655	1,56598	,16789
9. I understand printed texts better than texts on screen.	elementary school	93	3,3871	1,23387	,12795
	high school	87	3,3333	1,12753	,12088
10. I often read in English from my computer.	elementary school	93	2,9355	1,58667	,16453
	high school	87	3,8161	1,28975	,13828
11. I choose English as the language of the web page.	elementary school	92	3,1413	1,56600	,16327
	high school	87	3,7586	1,48610	,15933

12. I understand texts on screen better than on paper.	elementary school	91	3,0220	1,34146	,14062
	high school	86	2,6977	,98303	,10600
13. I read texts in English more often than in Croatian when I am at the computer.	elementary school	93	2,7742	1,41520	,14675
	high school	87	3,4368	1,47618	,15826
14. I borrow books in English from the library.	elementary school	92	1,4457	,83025	,08656
	high school	87	1,8276	1,19307	,12791
15. There is no difference between reading on screen and on paper.	elementary school	93	3,6989	1,33339	,13827
	high school	87	3,6322	1,33917	,14357
16. I read English more often on screen than on paper	elementary school	92	2,6304	1,39636	,14558
	high school	87	3,5402	1,42897	,15320

To check whether this is statistically significant, an independent-samples t-test was conducted. The results are visible in Table 21. Here is a list of statements for which there is a statistically significant difference in values for elementary school and high school:

The 1st statement: t (178)=-2.834, p=.005. The magnitude of differences in the means was small (eta squared=.0432). Expressed as a percentage, 4.32% of the variance in the mean values is explained by age.

The 2nd statement: t (143.146)=-3.715, p=.000. The magnitude of differences in the means was moderate (eta squared=.0727). Expressed as a percentage, 7.27% of the variance in the mean values is explained by age.

The 4th statement: t (175.051)=-2.861, p=.005. The magnitude of differences in the means was small (eta squared=.0442). Expressed as a percentage, 4.42% of the variance in the mean values is explained by age.

The 6th statement: t (177)= -4,334, p=.000. The magnitude of differences in the means was moderate (eta squared=.0959). Expressed as a percentage, 9.59% of the variance in the mean values is explained by age.

The 7th statement: t (168.174)=-2.051, p=.042. The magnitude of differences in the means was small (eta squared=.0232). Expressed as a percentage, 2.32% of the variance in the mean values is explained by age.

The 8th statement: t (178)=-3.455, p=.001. The magnitude of differences in the means was moderate (eta squared=.0628). Expressed as a percentage, 6.28% of the variance in the mean values is explained by age.

The 10th statement: t (174.651)=-4.097, p=.000. The magnitude of differences in the means was moderate (eta squared=.0862). Expressed as a percentage, 8.62% of the variance in the mean values is explained by age.

The 11th statement: t (177)=-2.702, p=.008. The magnitude of differences in the means was small (eta squared=.0396). Expressed as a percentage, 3.96% of the variance in the mean values is explained by age.

The 13th statement: t (178)=-3,070, p=.002. The magnitude of differences in the means was small (eta squared=.0502). Expressed as a percentage, 5.02% of the variance in the mean values is explained by age.

The 14th statement: t (152.566)=-2,473, p=.014. The magnitude of differences in the means was small (eta squared=.0334). Expressed as a percentage, 3.34% of the variance in the mean values is explained by age.

The 16th statement: t (177)=-4,308, p=.000. The magnitude of differences in the means was moderate (eta squared=.0949). Expressed as a percentage, 9.49% of the variance in the mean values is explained by age.

Here is a list of statements for which there is no statistically significant difference in values for elementary school and high school: the 3rd statement: t (178)=1.583, p=.115, the 5th statement: t (178)=-.476, p=.634, the 9th statement: t (178)=.305, p=.761, the 12th statement: t (164.948)=1.842, p=.067, the 15th statement: t (178)=.335, p=.738.

Table 21: Results for independent samples t-test (age), questionnaire

Independent Samples Test

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
| | | | | | | | | | 95% Confidence Interval of the Difference | |
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
1. I read for pleasure.	EVA	,112	,738	-2,834	178	,005	-,58102	,20499	-,98554	-,17649
	EVNA			-2,836	177,538	,005	-,58102	,20488	-,98533	-,17670
2. I use my computer every day.	EVA	34,338	,000	-3,647	178	,000	-,44197	,12120	-,68115	-,20280
	EVNA			-3,715	143,146	,000	-,44197	,11898	-,67716	-,20678

Item		F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	Lower	Upper
3. I use my computer mostly for Facebook, MSN etc.	EVA	1,838	,177	1,583	178	,115	,29551	,18667	-,07286	,66388
	EVNA			1,589	177,628	,114	,29551	,18597	-,07148	,66250
4. I use my computer for school assignments.	EVA	4,124	,044	-2,848	177	,005	-,50462	,17721	-,85433	-,15491
	EVNA			-2,861	175,051	,005	-,50462	,17641	-,85278	-,15646
5. My English teacher uses a computer in class often.	EVA	,549	,460	-,476	178	,634	-,07341	,15408	-,37748	,23065
	EVNA			-,476	177,055	,634	-,07341	,15411	-,37755	,23072
6. I read books other that assigned book reports.	EVA	,014	,907	-4,334	177	,000	-1,00725	,23242	-1,46592	-,54857
	EVNA			-4,335	176,643	,000	-1,00725	,23235	-1,46579	-,54871
7. I read e-books.	EVA	4,438	,037	-2,062	177	,041	-,38106	,18485	-,74584	-,01628
	EVNA			-2,051	168,174	,042	-,38106	,18575	-,74776	-,01436
8. I read newspaper on the internet.	EVA	1,037	,310	-3,455	178	,001	-,77197	,22343	-1,21288	-,33106
	EVNA			-3,445	173,753	,001	-,77197	,22410	-1,21428	-,32966
9. I understand printed texts better than texts on screen.	EVA	,909	,342	,305	178	,761	,05376	,17655	-,29464	,40217
	EVNA			,305	177,906	,760	,05376	,17602	-,29359	,40112
10. I often read in English from my computer.	EVA	8,760	,003	-4,069	178	,000	-,88061	,21640	-1,30764	-,45358
	EVNA			-4,097	174,651	,000	-,88061	,21492	-1,30478	-,45643
11. I choose English as the language of the web page.	EVA	1,468	,227	-2,702	177	,008	-,61732	,22846	-1,06817	-,16646
	EVNA			-2,706	176,997	,007	-,61732	,22812	-1,06751	-,16712
12. I understand texts on screen better than on paper.	EVA	4,976	,027	1,826	175	,070	,32430	,17761	-,02624	,67485
	EVNA			1,842	164,948	,067	,32430	,17610	-,02340	,67201
13. I read texts in English more often than in Croatian when I am at the computer.	EVA	,614	,434	-3,074	178	,002	-,66259	,21553	-1,08790	-,23727
	EVNA			-3,070	175,904	,002	-,66259	,21583	-1,08854	-,23664
14. I borrow books in English from the library.	EVA	11,699	,001	-2,497	177	,013	-,38193	,15295	-,68377	-,08010
	EVNA			-2,473	152,566	,014	-,38193	,15445	-,68706	-,07680
15. There is no difference between reading on screen and on paper.	EVA	,077	,782	,335	178	,738	,06674	,19930	-,32655	,46003
	EVNA			,335	177,097	,738	,06674	,19933	-,32662	,46010
16. I read English more often on screen than on paper	EVA	,127	,722	-4,308	177	,000	-,90980	,21120	-1,32660	-,49299
	EVNA			-4,305	175,895	,000	-,90980	,21134	-1,32688	-,49271

Table 22 shows that answers to the first of the two open questions at the end of the questionnaire *(How much time do you spend at the computer per day?)* were dispersed, with the mean value of M=3.69, SD=3.01.

Table 22: Descriptive statistics, open question no. 1

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
How much time do you spend at the computer per day?	175	,00	24,00	3,6914	3,00893
Valid N (listwise)	175				

As it is visible from Table 23, the participants' answers included both extremes, from no time at all spent at the computer to 24 hours a day spent at the computer. As high as 27.4% of the participants spend 3 hours a day at the computer, 23.4% spend 2 hours a day at the computer, 17.1% spend 4 hours a day at the computer and 9.1% of the participants spend 5 hours a day at the computer. This makes up 78.9% of the sample that spend two to five hours a day at the computer.

Table 23: Frequencies, open question no. 1

How much time do you spend at the computer per day?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	none	2	1,1	1,1	1,1
	1 hour/day	15	8,3	8,6	9,7
	2 hours/day	41	22,8	23,4	33,1
	3 hours/day	48	26,7	27,4	60,6
	4 hours/day	30	16,7	17,1	77,7
	5 hours/day	16	8,9	9,1	86,9
	6 hours/day	13	7,2	7,4	94,3
	7 hours/day	3	1,7	1,7	96,0
	8 hours/day	1	,6	,6	96,6
	10 hours/day	1	,6	,6	97,1
	12 hours/day	1	,6	,6	97,7
	13 hours/day	1	,6	,6	98,3
	15 hours/day	1	,6	,6	98,9
	24 hours/day	2	1,1	1,1	100,0
	Total	175	97,2	100,0	
Missing	System	5	2,8		
Total		180	100,0		

The differences in the mean values of how much time the participants spend at the computer per day between elementary school and high school participants were explored. It can be seen from Table 24 that descriptive statistics show that high school participants have a higher mean value (M=3.84, SD=3.48) of time spent at the computer per day than elementary school participants (M=3.55, SD=2.52).

Table 24: Group statistics (age), open question no. 1

Group Statistics

	age	N	Mean	Std. Deviation	Std. Error Mean
How much time do you spend at the computer per day?	elementary school (7th graders)	92	3,5543	2,51747	,26246
	high school (2nd graders)	83	3,8434	3,48335	,38235

To check whether this is statistically significant, an independent-samples t-test was conducted. As can be seen in Table 25 there was no statistically significant difference in values for elementary school and high school t (173)=-.633, p=.527.

Table 25: Results for independent samples t-test (age), open question no. 1

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
How much time do you spend at the computer per day?	EVA	,000	,993	-,633	173	,527	-,28903	,45630	-1,18965	,61160
	EVNA			-,623	147,896	,534	-,28903	,46376	-1,20549	,62743

Table 26 shows that the answers to the second of the two open questions at the end of the questionnaire *(After how much time spent at the computer do you start feeling tired?)* were dispersed, with the mean value of M=2.51, SD=3.21.

Table 26: Questionnaire descriptive statistics, open question no. 2

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
After how much time spent at the computer do you start feeling tired?	176	,00	24,00	2,5114	3,20890
Valid N (listwise)	176				

As it is visible from Table 27, the participants' answers included both extremes, from never getting tired while at the computer to getting tired after spending 1 hour at the computer. 14.8% of the participants start feeling tired after spending 2 hours at the computer, 10.8% starts feeling tired after spending 3 hours at the computer, 10.2% starts feeling tired after spending 4 hours at the computer and 9.7% starts feeling tired after spending 1 hour at the computer. The most surprising number is that as high as 35.8% of the participants never feel tired while at the computer.

Table 27: Frequencies, open question no. 2

After how much time spent at the computer do you start feeling tired?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	never	63	35,0	35,8	35,8
	After 1 hour	17	9,4	9,7	45,5
	After 2 hours	26	14,4	14,8	60,2
	After 3 hours	19	10,6	10,8	71,0
	After 4 hours	18	10,0	10,2	81,3
	After 5 hours	16	8,9	9,1	90,3
	After 6 hours	4	2,2	2,3	92,6
	After 7 hours	4	2,2	2,3	94,9
	After 8 hours	2	1,1	1,1	96,0
	After 10 hours	2	1,1	1,1	97,2
	After 12 hours	3	1,7	1,7	98,9
	After 16 hours	1	,6	,6	99,4
	After 24 hours	1	,6	,6	100,0
	Total	176	97,8	100,0	

Missing	System	4	2,2
Total		180	100,0

Next, the differences in the mean values of the time after which the participants start feeling tired while at the computer between elementary school and high school participants were explored. It can be seen from Table 28 that descriptive statistics show that high school participants have a higher mean value (M=2.76, SD=2.91) of the time after which the participants start feeling tired while the computer than elementary school participants (M=2.27, SD=3.47).

Table 28: Group statistics (age), open question no. 2

Group Statistics

	age	N	Mean	Std. Deviation	Std. Error Mean
After how much time spent at the computer do you start feeling tired?	elementary school (7th graders)	91	2,2747	3,46752	,36349
	high school (2nd graders)	85	2,7647	2,90585	,31518

To check whether this is statistically significant, an independent-samples t-test was conducted. As can be seen in Table 29, there was no statistically significant difference in vales for elementary school and high school t (174)=-1.012, p=.313.

Table 29: Results for independent samples t-test (age), open question no. 2

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
After how much time spent at the computer do you start feeling tired?	EVA	,251	,617	-1,012	174	,313	-,48998	,48401	-1,44526	,46530
	EVNA			-1,018	172,022	,310	-,48998	,48111	-1,43962	,45966

3.6. Discussion

Unlike similar research that dealt with the issue of reading from screen versus reading from paper, this study proved that, in the selected sample, there was no statistically significant difference in the test scores between the participants who read from screen and the participants who read from paper. Like Gould et al. (as cited in Dillon et al., 1988) stated, the more similar the computer screen is to real paper, the fewer differences in comprehension there will be, and this research confirmed his prediction. Contemporary computer screens are so advanced in their technology that the problems that were encountered by the participants investigated by Gould et al. (as cited in Dillon et al., 1988) are nowadays nearly solved. Not only have screens improved a lot, in terms of their aspect ratio, flicker, image polarity, visual angle etc., but with the new devices such as iPads, screen has indeed become paper-like, as you can pick it up, move it around, write on it etc. The participants proved that they could read and comprehend a text on a computer screen just as well as they can from paper. Furthermore, the mean score of reading from screen was 0.55 higher than the mean score of reading from paper. This difference was not statistically significant, but still nicely exemplifies just how much the participants are acquainted with computers.

On the other hand, when the elementary school and high school groups which were both reading from screen were compared, the difference between the mean scores was statistically significant. High school participants did much better than elementary school participants, and as much as 16.05% of the variance in scores can be explained by the difference in age. This might be explained by the fact that high school participants have throughout their life and school experiences spent more time reading in general, reading in EFL, developing reading as a skill and improving their reading strategies. Due to their age they have also had more time to have more experiences with computers and thus with reading from screen. There was also a statistically significant difference of the usage of computers for school assignments which proves that the participants from high school are required to use the computer more often for school purposes. High school participants also read for pleasure more, read books other than assigned book reports more, read e-books more and read newspaper on the internet more than elementary school participants, which proves that high school participants have more practice in reading, which led them to better test scores. These differences could also be explained by the maturity of the participants, their goals in life (it would be safe to assume that the vast majority of the high school students will apply for college, which is not true for all the elementary school students), their family background and personal, family and community culture of reading. The fact must

not be ignored that the participants at hand differ quite a bit, because grammar school students are typically those that were excellent throughout their elementary school. Therefore, the participants are former excellent elementary school students versus typical, elementary school students with a very differing GPA, from insufficient to excellent. The test score difference could not, however, be attributed to the difference in vocabulary and grammatical structures knowledge of the participants, since the reading texts were age appropriate and approved by their teachers. The goal was for the text to be comprehensible, but following the principle '*i+1*' to have just a few partially unknown words, so that it is not too simple, and also to keep them interested. Nevertheless, higher metacognitive strategies that allow learners to control their own cognition, i.e. to coordinate the learning process and more developed reading skills might have had an impact on the results (and these are, most likely, further developed in older participants).

The differences in the test results between the two groups of high school and elementary school students which were reading from paper, were not statistically significant, nor were the differences in how much time they spend at the computer per day. It could be concluded from this that it is not the time spent at the computer that matters and aids reading comprehension, but how that time is spent. High school participants use the computer more for school purposes, and therefore did better when reading from screen. From this, it could be concluded that in order to aid comprehension while reading from screen, students should be given regular assignments, because as all skills, reading from screen also needs plenty of practice. Since there was no difference in reading from paper, and a statistically significant difference in reading from screen, in the overall comparison (both media included), high school students again did better than elementary school students. This time, 5.06% of the variance could be attributed to the age difference, and this again goes in line with the previously stated arguments that could be responsible for this difference.

As expected, there were no statistically significant differences between male and female participants.

When the medium is put as the grouping variable, there is no statistically significant difference in the test scores between elementary school students reading from screen and elementary school students reading from paper. This could be explained by the fact that this is the computer generation. The participants are thirteen years old, they have been acquainted with computers all their lives, they have probably started using the computer at some basic, pragmatic level at a very young age, maybe even at their preschool age. As seen from the results, the mean value of using a computer every day is very high, and this proves that the participants are in a day-to-day contact with computers and explains the fact that there is no significant difference in

the test scores. Not only has the 'screen' itself become more paper-like, but the daily experiences have also led to the development of skills, and all of these elements combined lead to good screen readers.

On the other hand, again in line with the previously stated arguments, there is a statistically significant difference in the mean values of using a computer every day: high school students use it more than elementary school students, therefore in their group there was a statistically significant difference in the test scores: students who read from screen achieved better scores than those who read from paper. Here we must take into consideration all that was said while explaining why elementary school students did as well while reading on screen as they did while reading from paper and what was said while explaining why high school students did better overall, and why they did better when elementary school and high school were compared in reading from screen. The fact that both of these generations were familiar with computers and using them at a very young age accounts for the fact that reading from paper did not provide better comprehension test results as opposed to reading from screen and in combination with the experience high school students have had with computer use for school purposes helped tip the bar in their direction Also, it is important to note that the mean value of the level of agreement with the 15th statement of the questionnaire *(There is no difference between reading on screen and on paper.)* is the third highest mean vales in the questionnaire. This somewhat contradicts the high mean value of the 9th statement (*I understand printed texts better than texts on screen.)*, but this can be explained by the fact that fluent reading is an unconscious and automatic process of which readers are often not aware of and therefore are unable to state correctly from which medium comprehension is better.

Final grades that the participants of the study had in English proved to be a good indicator of the potential test results, as the two variables had a strong, positive statistically significant correlation, which means that the final grade are a real, objective indicator of a student's knowledge and that the reading texts and comprehension questions were appropriate to the levels of knowledge of the two groups of students.

In the questionnaire analysis the lowest two mean values were the ones pertaining to reading habits in general and are disappointing, they mostly do not read e-books, nor do they borrow books in English from the library. These are an evidence of the poor culture of reading in our society and educational institutions and the fact that using the computer for social networks such as Facebook or MSN has the second highest mean value in the questionnaire demonstrates what the participants use the computer for. This can also be connected to the thesis that in order to improve not only the skill of reading from screen, but the reading skill in general, computers,

as a device students use practically every day should be utilized for school assignments. Students would be motivated to learn from a device they love using and perhaps be less aware that learning is taking place. In average, students spend 3-4 hours per day at the computer, which takes up most of their spare time, teachers should recognize this potential of computers, which should be used to improve reading as a skill, and not only seen as leisure time activity. An interesting fact is that although admitting they get tired while at the computer after only 2-2.5 hours, the mean value of time spent at the computer is, as previously noted, higher, which shows how much they like it. Again, this kind of will and resilience in students should be used to aid learning, and not underused as it is now (the majority of the participants disagreed with the statement that their teacher uses the computer in class often).

The correlations between the test results, the final grades and the questionnaire statements proved that the students who read for pleasure have a better grade in English and also did better on the comprehension test, students who admittedly use the computer mostly for Facebook, MSN and the like have a lower grade in English, and those who use the computer for school assignments often have a higher grade in English. This proves that at least some portion of the students' use of the computer should be planned and systematic and that this should aid learning, knowledge of English, reading in EFL skills and reading in general skills. The results provided another evidence for this showing that the students whose teacher used the computer in class often had better comprehension test results. The students who have a developed culture of reading, i.e. read books other than book reports and the students who often read in English when they are at the computer had both a higher test score and a higher grade in English. The fact remains that they are exposed to the most reading texts in English when they are at the computer, and this should be further developed by their English teachers by motivating them to read more and teaching them how to find good and useful texts on the web. The questionnaire analysis confirmed this thesis showing that high school participants, who had statistically significant better test scores, read in English on their computer more and choose English as the language of the web page more than elementary school participants. They also more often agree with the statement which says that they read in English on screen more often than on paper and that when they are at the computer, they read texts in English more often than in Croatian. All of these are further reasons why they did better than elementary school participants, why they did better on screen and why teachers should implement computers in their regular classes.

The students who choose English as the language of the web page, if they can choose it, had higher test scores and higher grades in English. This can be connected to their self awareness of their level of knowledge, i.e. to their own perceived competence. Therefore it is logical that

those who have a tangible evidence of their competence (a higher grade in English) feel more competent and choose to read in English, and since the grade and the test result, as previously shown, correlate positively, it is clear why the ones who had higher test scores also choose English. The same logic can be applied for the students who state that they read more in English than in Croatian when they are at the computer, with the note that it is most often so because there is no option of reading in Croatian, so they are somewhat forced to practice reading in English, which is one of the many reasons stated above why teachers should use the computers in their teaching more often. Again, practice makes perfect: the students who borrow books in English from the library had higher test scores and higher grades which proves that reading is a skill that needs to be practiced in order to become fluent, and comprehension comes with fluent reading (faster input of understood information aids comprehension). The questionnaire also proved that the students who read more in English on screen than on paper had higher test scores and higher grades, and the same goes for the students claiming there is no difference between reading from screen and reading form paper.

4. Conclusion

Reading as a process is complex, and the most important part of this process is comprehension and, later on, interpretation. Although many researchers emphasize the relevance of comprehension, the fact remains that without some of the most basic processes, like word recognition and syntactic parsing, comprehension is impossible. This is particularly evident in the 'English as a foreign language context' where readers have not had enough exposure to print to be able to read as automatically as fluent readers should and therefore comprehension is impaired. Keeping this in mind, even more difficulties occur when the medium of reading changes i.e. when students read from screen, or so it has been long thought.

The conclusions of research dealing with the differences between reading from screen and reading from paper have changed significantly in just twenty years because the technology has changed significantly also. The main pitfalls of reading from screen were static orientation, text layout, navigation issues, fatigue, eye strain etc. which made comprehension difficult. Nowadays, when screens are attributed with more and more paper-like characteristics, the differences in comprehension after reading from screen and reading from paper seem to disappear.

This study proved that there was no difference in comprehension after reading from the two media. Teachers should embrace the new technologies and adapt to them, because their students have also done the same. Participants spend most of their spare time at the computer, mostly on social networking sites, and very little time reading. This study proved that the students who read in their spare time have higher English grades than those who do not, and students who use the computer more often for school assignments have better comprehension test results.

Teachers need to use this insight and teach in a student-friendly way, by utilizing the device their students use the most and combine it with learning – this will make the learning more fun and motivating for the students. Teachers should guide them by using the computer in the classroom more often, not just as a media through which they learn something else, but explore the media itself, all its applications and programmes in learning and improving their reading skills. The young are fearless, and so should the teachers be. They should not be afraid of the improving technologies, but exploit them to make our lives better, as intended.

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