Significance of Line Length for Tablet PC Users

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Abstract. This paper presents key findings about on-screen optimal line length for tablet personal computers (PCs). It examines the effects of four different line lengths on the reading speed and reading efficiency. Seventy participants ranging between the ages of 20 and 40 participated in this study. They read four different texts with an average length of 2000 characters. The texts contained substitution words, which were to be detected by the subjects to measure reading accuracy. Moreover, the subjects were asked to subjectively vote on their reading experience in the context of subjective measures like reading speed and accuracy. The results of the study revealed that 90 characters per line (CPL) were preferred by most of the participants. Nonetheless, some participants falling between the ages of 35 and 40 years preferred 60 CPL. The findings presented in this paper are quite worthwhile as the Tablet PC are extensively used for e-reading. In essence, this study suggests optimal line length for reading on screen using Tablet PC and eventually benefiting people who use Tablet PC for reading, hailing from every walk of life.

Keywords: Optimal line length · Reading efficiency · E-reading · Substitution of words

1 Introduction

Electronic devices like Tablet PCs and e-readers are widely used these days. According to the Pew Internet and American Project 34 % of the adults in USA are having Tablet PC [10]. This study has shown that people belonging to all walks of life and of every age use Tablet PC for accessing textbooks and other reading material. This paper

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communicates the empirical findings about determining an *optimal line length* for reading using Tablet PC. The terms line length and optimal line length are defined in Sects. 1.1 and 1.2, respectively. Results were obtained via questionnaires and survey forms were filled by target participants. A readability test was conducted using a survey, to find the right amount of characters for reading on Tablet PC. The participants were asked to vote about their preferred line length using Tablet PC and their data was collected for analysis. Today, majority of the users prefer Tablet PC for reading books and other information online. Consequently, this research provides a contribution towards the field of e-reading. On one hand, publishers can benefit from the results of this research for publishing books and papers for portable devices like Tablet PC. On the other hand, users will also profit from this research as they will experience faster reading. The important terms used in this paper are defined as follows:

1.1 Line Length

Line length of a text is a measure i.e. the physical length of a line (e.g. by adjusting margins) or it can be measured by characters in a line. The line length display devices due to different screen sizes on different devices such as Laptop, Desktop, Tablet PC and others. It also depends on features such as single column or multi column documents, the amount of text containing number of words and the number of characters available in a single line.

1.2 Optimal Line Length

Optimal line length has a proper amount of text in a single line. Moreover, it makes a line easily readable by users, who read books, newspapers or any other reading material, using a Tablet PC's screen display. It can be obtained by having an appropriate amount of text present in a line which makes users comfortable to read, from the available reading material on a Tablet PC.

1.3 Importance of Optimal Line Length

It is an essential element to have an optimal line length for the readers in order to avoid reading errors. Most of the time readers make mistakes while reading text which is not clearly presented in magazines, books and onscreen using Tablet PC or e-readers [11]. Most of the books and newspapers have varying text styles which lead readers towards making mistakes [12]. Having the right amount of characters on each line is important for the "readability of text".

Figure 1 shows a sample of different line lengths available for the readers while reading from different sources like online reading material. First paragraph in the figure contains 85 characters per line while the second paragraph contains 120 characters per line and the third paragraph has 120 characters per line with small text size.

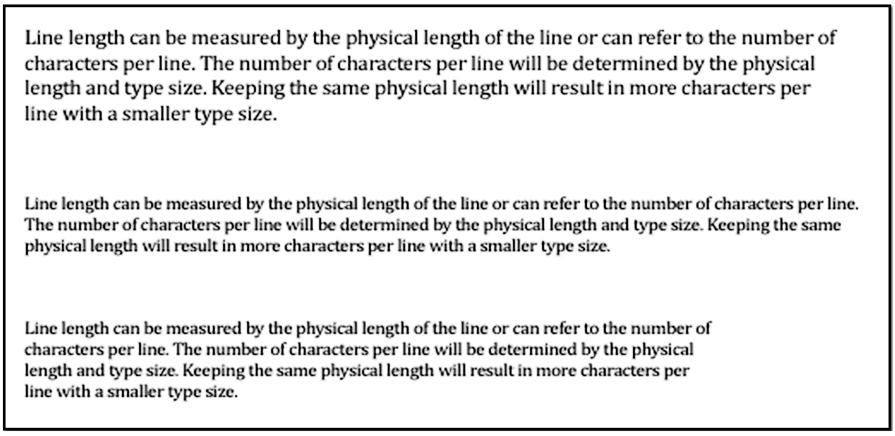

Fig. 1. Sample of different line lengths

Figure 1. The excerpt shows the sample of different line lengths available for the readers while reading from different sources. First paragraph in the figure contains 85 characters per line while the second paragraph contains 120 characters per line and the third paragraph has 120 characters per line with small text size.

2 Previous Studies

Los Angeles Unified District approved iPads for every child in the district's schools [10]. According to a survey, 34 % of the adults own a Tablet PC in USA [11]. In January 2012, 29 % of U.S. adults of 18 years of age and older are using Tablet PC devices for reading electronic text e.g. Kindle or Nook [12]. According to the data about the use of a Tablet PC, collected by Springer book publisher surveys, five educational institutions in Europe, US, and Asia had found that 73 % of readers used e-books, with most accessing e-books on a weekly or monthly basis. The line length of a text in online books is far different from newspapers. It has been seen that most of the newspapers use very narrow line length in their publications. However, wider line lengths are used for publication of books. On screen readability has variant line length because of multiple sizes of screens. Weber conducted a study on "Line length of newspapers and books" and found that in newspapers and books the line length need to be four inches and it should never exceed than six inches [2]. According to Tinker et al., the best line length for reading books and other information need to be between 3 and 3.5 inches [1]. Moreover, they found that if the line length exceeds 7.5 inches, it becomes very difficult for the reader to find the next line after finishing the first line. Ducknicky et al. were the first to find out the optimal line length for onscreen readability [3]. They went on saying that if the text is stretched to full screen it becomes easier to read than the text only filled one third of the screen. Dyson et al. shows that the reading efficiency of the readers increases by more number of letters per line [4]. Bernard et al. examined three different line lengths (3.3, 5.7 and 9.6 inches) with same

size of text that was 12 points in times new roman [5]. The results of the experiments performed by Shaikh were similar with the study conducted on difference of reading speed for efficiency conducted by Shaikh [6]. The study investigated the line length for reading online newspapers and books vs. paper based reading. On the other front, in most of the studies it can be seen that longer line lengths lead towards faster and efficient reading while medium line lengths lead towards the average reading. In view of this the readers preferred line length between 90 CPL to 120 CPL. Previous studies did not focused on different environments where the people may read using a portable device. However, this study focused on indoor and outdoor environments for reading using Tablet PC.

As early as the 1980s, studies dealing with the comparison between screen and paper emerged in the scientific community, reacting to the basic change in methods of displaying information occasioned by the introduction of the Personal Computer (PC) across office sites [7].

As a result of this development, people often prefer to access information on computers because of the accessibility of the information, the ability to change text to the desired size, ease of archiving and organization, the avoidance of paper costs and reduction of paper use, and environmental benefits [8].

Researchers still lack information on "how readers actually engage with these different formats of digital text vs. printed text, their reasons for choosing one format over another [9]".

3 Problems Faced During on Screen Reading

Researchers working on readability for the last many decades highlighted various issues in readability which includes Font Size, Text Style, Number of words per line and Number of characters per line. This study focuses on characters per line (CPL) aspect while reading on-screen, using a Tablet PC. These issues are very common and faced by most of the users using Tablet PCs for e-reading. This study helps to overcome the issues by providing the optimal line length for e-reading. In this connection, this research covers many aspects of the on-screen readability by focusing on the different users in different environments such as indoor and outdoor usage of Tablet PC. Different age groups were considered for this research in order to obtain better results for this study and to overcome the problems of various readers in the domain of e-reading.

3.1 Critical Parameters for Efficient Online Reading for Tablet PC

The correct parameters for online reading are reading speed, reading efficiency and reading comprehension by finding the mistakes in the text. It is very common to have proof reading mistakes while reading any text online. Thus, to overcome these problems this study focused on the parameters mentioned earlier. The experiments were designed in a way so that the parameters of this research work can be obtained; Shaikh [6] used the same design pattern for the parameters mentioned above having slight

difference. They have performed the tests using desktop computers. Such issues are faced while reading text in different conditions like traveling where reader is unable to focus on the text and in different environments. It becomes totally different to read on-screen while you are in your office or any other indoor place but when the Tablet PC is used in outdoor environments. Reading efficiency of the users is affected depending upon the place and environment. Tablet PC is a portable device so all these problems are always present while using Tablet PC, because it can be used anywhere like in office or travelling so these all points need to be taken in consideration.

4 Methodology

The readability tests of this study focused on subjective method of collecting the data from various participants. The subjective method was applied using questionnaires, interviews, surveys and feedback forms. Every participant filled one of each forms like questionnaire, survey and feedback. The questionnaires and feedback forms were designed by following famous online survey platforms like survey monkey. The participants used Tablet PC for reading on-screen. The subjective method was used so that the participants can express their opinion about their reading experience. In this method participants were provided with questionnaires, survey forms and feedback forms to gauge "on screen readability". The participants were asked to provide their prior information about the optimal line length in terms of character per line while reading on a Tablet PC. Selection of the participants was based upon different age groups, qualification, experience in terms of computer usage and different fields. The selection of the participants was done based upon different age groups and qualification level. Every participant was asked to read four different texts containing same amount of words, each text contained substitute words which were intentionally replaced and participants were asked to detect those words while reading the text from Tablet PC.

5 Results

The results were generated from the data collected through subjective method. These results contain only subjective data, the first part of the data was based on participants' demographic data which is based upon the participants information relating to their age groups, level of education and experience in using computers. On the other hand, the second part of the data was based on participants' preferences regarding the optimal line length for Tablet PC.

5.1 Demographic Data

Table 1 illustrates the number of male and female participants of the study. Table 2, on the hand, provides insights into the distribution age among the participating users. While Table 3, distinguishes participating user groups according to their educational background. The participants have been selected in this way to represent the major user groups on a regional level.

The information in the following Table 4 provides data about the participants having computer usage experience in terms of years.

Table 1. Number of Male and Female Participants

S no.	Gender	No: of Participants
1	Male	50
2	Female	25

Table 2. Age groups of the participants

S no.	Age groups in terms of years	Number of participants
01	20–25	22
02	25–30	19
03	30–35	16
04	35–40	13

Table 3. Qualification level of participants

S no.	Education level	No: of participants
1	Undergraduate	35
2	Post graduate	15
3	Others	20

Table 4. PC usage experience of the participants

S no.	PC experience in years	No: of participants
01	4 years	30
02	6 years	22
03	8 years	13
04	10 and above years	10

5.2 Subjective Data

The results of this study are visualized in the form of pie-charts in the figures from Figs. 2, 3, 4 and 5 based on the subjective data collected from the participants. The pie-charts, plotted in these figures as per various age groups from 20 to 25 years, from 25 to 30 years, from 30 to 35 years and from 35 to 40 years of age groups respectively. From the figures, the results show that the majority of the participants preferred 90 CPL over other line lengths, altogether. In Figs. 3 and 5 preferred line length is 60 CPL, while in Fig. 2 the participants selected 90 CPL while 120 CPL was the second preference.

As per the results portrayed in Fig. 3, 90 CPL is highly preferred by the participants whereas Fig. 4 clearly indicates that participants of the age group of 30 to 35 years like 60 CPL for on screen readability. However, according to Fig. 3 there is tendency of participants to like 60 CPL for reading as well. According to Fig. 5, the age group of 35 to 40 years prefers 30 CPL the most, for reading from Tablet PC screen.

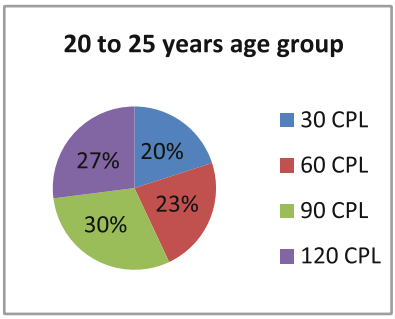

Fig. 2. Preference of 20 to 25 years of age group participants

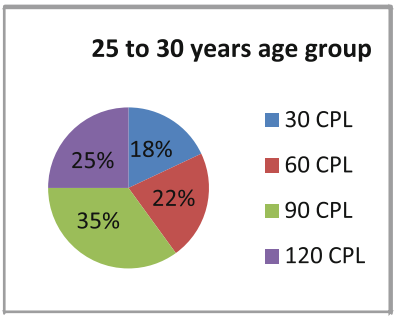

Fig. 3. Preference of 25 to 30 years of age group participants

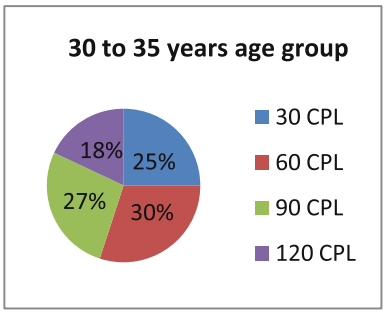

Fig. 4. Preference of 30 to 35 years of age group participants

6 Discussion

The subjective results show that most of the users preferred 90 CPL when they read any text on Tablet PC. The participants were divided into four age groups (i) 20 to 25 years (ii) 25 to 30 years (iii) 30 to 35 years and (iv) 35 to 40 yrs. A key factor that was

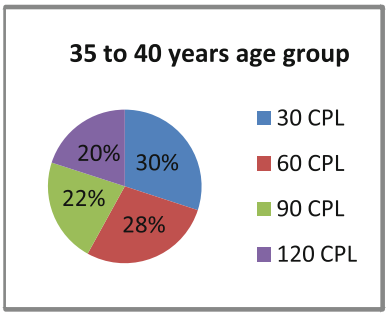

Fig. 5. Preference of 35 to 40 years of age group participants

noticed that people belonging to age groups (i) and (ii) preferred 90 and 120 CPL. The above figures show the preference of 20 to 30 years age group participants, horizontal line shows the characters per line while vertical line shows the preference of the participants in terms of percentage.

However, the participants from 30 to 35 years and 35 to 40 years preferred 60 CPL. During the feedback when the participants were asked about their preferred line length, it was found that people of group (iv) and above selected 60 CPL because of eye sight issues and participants from age group of 20 to 25 and 25 to 30 years preferred 90 CPL on first priority and second was 120 CPL. The reason behind their choice was that they felt more comfortable while reading more number of characters per line and their reading speed also increased when they read longer lines on a Tablet PC screen. During the tests participants were asked about the problems that they face. Moreover, color blindness test was also conducted of every participant participating in the readability surveys of this study (Figs. 6, 7).

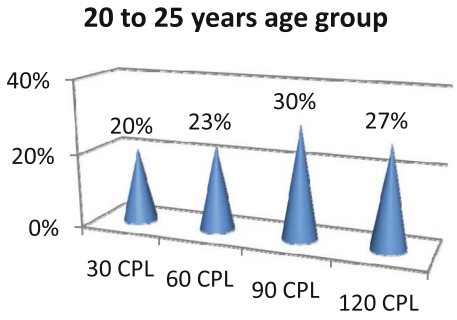

Fig. 6. Preference of participants of 20 to 25 yrs.

The readability tests were conducted in a university environment and that is the reason why the age groups of participants were from 20 to 40 years. The participants were mostly students and university teachers. The text used in the readability contained same font size of 12 pts and same font style Times new roman because of the consistency. All the participants were non-native English speakers. This applies to the

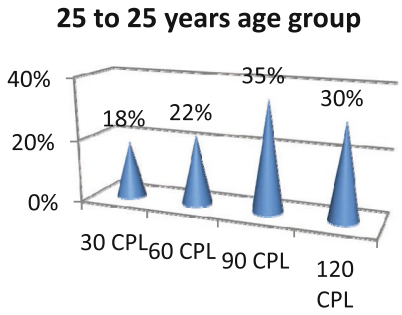

Fig. 7. Preference of participants of 25 to 30 yrs.

majority of the population in the world, which are non-native speakers. Moreover, this research focuses on the participants from Pakistan. Results might have been slightly different if the same research work would have been carried out in different countries with different languages. There is a need to have a similar type of research work with the participants belonging to different language groups as well as different cultures. Moreover, older age groups can be included in future to conduct further experiments.

7 Conclusion and Future Work

In this research work, it was found that majority of participants preferred 90 CPL over other variants of CPL. Participants of age group from 20 to 30 years liked longer lines while reading on a Tablet PC. Whereas, the participants of 30 to 40 years of age group preferred 60 CPL. Results indicate that as people grow older they find difficulties while reading on a Tablet PC screen. There are numerous reasons for such difficulties such as eye sight problems [1]. Many participants of older age found that it was hard reading longer lines on a Tablet PC. Furthermore, it is evident from this study that younger adults from age group of 20 to 30 years like longer line length 90 CPL to 120 CPL, however, people of older age prefer shorter lines (i.e. having lesser number of characters), while reading on a Tablet PC screen. The previous studies were mainly conducted on larger screens such as desktop computers and laptop screens. Desktops computers are mostly used indoor, for instance; in offices or homes. However, a Tablet PC is a portable device; therefore, there is a substantial difference in environments as well as mobility aspects. Reading on a screen in an office and reading while moving in a bus or any other outdoor mobile environment has totally different effects on readability. This work covers most of the aspects of the users using Tablet PC regularly, as already discussed above. Furthermore, this work recommends that 90 CPL is preferred for publishing books and papers for e-reading. In future, this study will be further extended by collecting additional data through more experiments by including more participants. Moreover, these results will be compared with subjective results to find out the difference between the participants' actual choice of line length while reading on Tablet PC and their subjective opinion. Besides, this work will be further continued for additional mobile devices having different screen sizes and also based on different operating systems.

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