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| Research Article / Araştırma Makalesi |

The Relationship Between Readability and Text Design in Educational Websites[1]

Eğitsel İçerikli Web Sitelerinde Okunabilirlik ve Metin Tasarımı Arasındaki İlişki

Fatma Keskinkılıç[2], Serçin Karataş[3]

Keywords

1. Readability
2. Educational Website Design
3. Readability of Educational Websites
4. Text Design

Anahtar Kelimeler

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Abstract

*Purpose: P*urpose of this study is to investigate the readability levels of the websites that have educational contents.

Design/Methodology/Approach: Web-site readability is generally examined through the structural properties of the texts, or their physical properties. This research performs readability measurements are performed by employing both of the above-mentioned methods.

Findings: The findings illustrate that half of the websites are at the medium difficulty level, 20% of the remaining websites are easy, and 30% of them are difficult in terms of readability. It is concluded that readability and text design levels of the investigated websites are consistent with each other.

Highlights: The most important features in terms of text design elements in educational websites are the tonal value of the text that makes it easier to read, the balanced use of the spaces between the letters, attention to the text integrity in the text, the listing levels not exceeding two levels, and the clickability of the links. It has been seen that the least considered features in terms of text design elements in educational websites are glossary and bibliography arrangement, not including scroll bars, explaining links with texts, distinguishing visited links, inverted pyramid technique, using in-page links. It has been seen that the texts on the educational websites are at a medium difficulty level according to the text design elements scale. According to the result obtained from the readability formula of the texts on the educational websites, it was seen that the readability levels were at the medium difficulty level.

Öz

Çalışmanın amacı: Bu çalışmanın amacı, eğitsel içerikli web sitelerinin okunabilirlik düzeylerinin araştırılmasıdır.

Materyal ve Yöntem: Web sitesi okunabilirliği genellikle metinlerin yapısal özellikleri veya fiziksel özellikleri üzerinden incelenir. Bu araştırma, yukarıda belirtilen yöntemlerin her ikisi de kullanılarak okunabilirlik ölçümleri gerçekleştirir.

Bulgular: Elde edilen bulgular okunabilirlik açısından web sitelerinin yarısının orta zorluk seviyesinde, kalan web sitelerinin %20'sinin kolay ve %30'unun zor olduğunu göstermektedir. İncelenen web sitelerinin okunabilirlik ve metin tasarım düzeylerinin birbiriyle uyumlu olduğu sonucuna varılmıştır.

Önemli Hususlar: Eğitsel web sitelerinde metin tasarım öğeleri açısından en önemli özellikler metnin okumayı kolaylaştıran ton değeri, harfler arasındaki boşlukların dengeli kullanımı, metinde metin bütünlüğüne dikkat edilmesi, listeleme düzeylerinin iki düzeyi geçmemesi ve bağlantılara tıklanabilirlik hissinin verilmesi olarak karşımıza çıkmaktadır. Eğitsel web sitelerinde metin tasarım öğeleri açısından en az dikkate alınan özellikler ise sözlük ve kaynakça düzenlemesi, kaydırma çubuklarına yer verilmemesi, bağlantıların metinler ile açıklanması, ziyaret edilmiş bağlantıların ayırt edilmesi, ters piramit tekniği, sayfa içi bağlantıların kullanılması olduğu görülmüştür. Eğitsel içerikli web sitelerinde yer alan metinlerin, metin tasarım unsurları ölçeğine göre orta güçlük düzeyinde olduğu görülmüştür. Eğitsel içerikli web sitelerinde yer alan metinlerin okunabilirlik formülünden alınan sonuca göre okunabilirlik düzeylerinin orta güçlük düzeyinde olduğu görülmüştür.

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[2] **Corresponded Author,** Kırşehir Ahi Evran University, Vocational School of Technical Sciences, Department of Computer Technologies, Kırşehir, TÜRKİYE; https://orcid.org/ 0000-0003-3619-4620

[3] Gazi University, Education Faculty, Education of Computer and Instructional Technologies, Ankara, TÜRKİYE; https://orcid.org/ 0000-0002-1731-0676

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INTRODUCTION

Communication environments present information and a rich communication environment with the tools appealing to multiple senses. Wroblewski (2002) attributes the web as a communication medium to the fact that millions of people and institutions come together in this medium. The exact number of people communicating on the web can vary greatly depending on the time frame, platform, and region. It's important to note that this number is constantly changing due to global internet penetration rates, technological advancements, and other factors. He states that when communicating through the web, it is necessary to know your audience, what and how to say; thus, effective web design leads to effective communication.

The web has revealed some deficiencies and problems in effective communication. People communicate with each other through many different channels such as the internet, face-to-face conversations, phone calls, text messages, e-mails, social media platforms, video conferencing, instant messaging applications and websites. Social media and the web have a huge impact on accessing and sharing information today. Thanks to the web, people can access a wide range of information quickly. Social media platforms also accelerate the dissemination of this information. Social media can provide quick access to current events and news. However, this speed can sometimes lead to problems with accuracy and detail. In terms of obtaining information, the web provides access to a wide range of reliable sources, official sites, and information providers such as university libraries. It offers the chance to access in-depth and reliable information on various subjects. You have the opportunity to verify information by examining the sources of the websites. Sources such as academic sources, official documents, and reliable news sites are generally more reliable. The websites enable the masses communicate their messages by reaching wider dimensions. A communication environment with its content and features is easy to use, economical, and flexible in terms of place and time. It succeeds in reaching the targeted audience better than the other communication channels. Websites allow any desired subject to be presented and shared as preferred (Pektaş, 2001). Due to its nature of flexibility, this environment might present some unreliable information or might cause miscommunication.

On the web, the message is transmitted by the source through coding in various forms such as text, image and sound. This function of multimedia attracted computer users to create web pages, and this has caused some visual pollution without realizing it (Pektaş, 2001). But it should not be forgotten that the text forms most of a narrative (Bochkay, Brown, Leone, & Tucker, 2023).

As the internet is available to everyone without restrictions, it allows its users to create any kind of content. The web designers should avoid misusing their freedom over the design of the content, thereby restricting the users' ability to distinguish the given information. These adverse situations might cause the site visitors, who are as free as the site designers, to leave the site. If the aim is to have the users perceive the transmitted message easily, accurately and without requiring much time; having a background in design, mastering the content and characteristics of the audience necessitate.

Most visitors to websites have a specific goal; some aim to get information about a product, some to learn about a topic. Though the goals seem different, in essence, the visits aim to get the information (Doğan, 2006). This emphasizes the critical role that web content plays in catering to diverse user intentions and delivering the necessary information effectively. According to the 2007 Household Information Technologies Usage Survey carried out by the Turkish Statistical Institute (TUIK, 2021), 90% of household members use the internet to search for information, 80 % to communicate, 52% to engage in educational activities, 26% to contact the public organizations/ institutions. The same survey results from 2021 show that the rate of households with internet access increased to 92%. 2021 survey illustrates that the rate of the internet usage is 82% in the 16-74 age group; 80% of this age group use the internet regularly- everyday or a few times a week. These results show that there is a high rate of internet use among individuals who benefit from information services. In today's conditions, the rate of internet usage is not only for individuals who benefit from information services; It has become an indispensable part of the daily life of all people in general, especially after the global COVID-19 pandemic. During the pandemic period, all educational institutions had to move their services online; therefore, the number of people seeking information online from all fields has increased significantly. As learning from in web-based environments is being used increasingly, it has become more important to determine how to visually design digital text to support student learning (Jin, 2013). In parallel, information design in online environments continues to attract more attention. A good planning is the basis of any design; When the collected information is properly organized, classified and presented effectively, it offers ease of perception for the receiver. Irregular text and picture elements prevent perception and communication and may cause misunderstandings (Pektaş, 2001).Studies on usability report that users briefly visit websites to obtain information and leave the website immediately after they get the information. Hence, providing a web design with proper interaction enables users to access the information easily (Üstündağ, 2002). It is vital that building an effective communication with the user ensures an accurate online interaction.

The web has gained popularity in transferring information from one place to another (Ojha et al., 2021). Doğan (2006) identifies online communication mainly as text based. Nielsen (2015) points out the importance of tone of voice and content for online communication; however, their effectiveness relies on reaching the users. If users do not read the text, the goal cannot be achieved. Considering the significance of text/content, web designers need to focus on the most effective and fast ways of conveying the meaning. According to Doğan (2006), web content differs from traditional text as web users prefer to browse and filter instead of reading the whole text. In Nielsen's (1997), study on reading preferences of users, 79% of the users are found to scan and browse the webpage while only 16% read the text on the page. Based on these findings, Nielsen emphasizes the need for easy-to-scan texts while designing the text of web pages. Moreover, Moran (2020) states that people rarely read the text word-

by-word online; they are more likely to scan the content. This fact of online information-seeking behavior has remained the same for many years and has had significant implications for digital content creation. As seen in Nielsen's work, for effective message transmission, the website's feature of easy scanning is a prerequisite. To do so, the visual balance between text and images needs to be well established; colors, formatting and organization of web elements need to be balanced with attention getting features. The eye should be able to follow the movement on the page with ease to catch the information flow. Communicative meaning of writing/text need to be performed to achieve the purpose (Pektaş, 2001). In this context, web designers should pay attention to not only the physical characteristics of the textual information but also the content itself. Given the popularity of web content, analysis of its readability deserves more attention (Antunes & Lopes, 2019). For effective web design, the text design elements that include readability, ease of scanning and physical properties of texts need further examination.

Research on online texts mainly focuses on the concept of readability and physical properties of texts such as color, size, and font. The literature focuses on the readability of websites, and readability formulas developed and tested for printed materials such as books, magazines and newspaper. The results of the readability formula attempt to provide guidance to the designers about which age group or education level their websites appeal in terms of text difficulty level. Some researchers perceived web readability as typographic features such as the color and size of the text and evaluated the texts on the websites according to these features. Researchers differ in their approach to the readability of websites. Some researchers consider readability formulas based on the quantitative features of the text, such as the number of syllables and the number of words, while some base their decision on the physical characteristics of the online texts. Choosing one of these approaches might create confusion for the evaluators while evaluating a website in terms of readability. This study analyses this confusion as the problem of research.

Various evaluation methods have been utilized to evaluate the readability of text and web content. Since low readability directly affects the intelligibility of the content, the use of these evaluation methods for evaluation processes has been actively researched (Ojha et al., 2021). This research underlines the need to consider text design elements while evaluating the readability of the websites. Within this scope, this research aims to reveal a possible relationship between the measurements of readability of the texts on the educational websites based on Flesch's readability formula, and of text design features based on the scale developed for this research. In line with this purpose, the research seeks answers to the following questions:

1. What are the difficulty levels of the texts on educational websites according to the text design elements scale?
2. What is the readability level of the texts on educational websites according to the results from the readability formula?
3. Is there a significant relationship between the readability level determined by the readability formula and those determined by the text design elements scale?

A drastic increase has been observed in the number of online education services and in the development of online educational content. These websites are generally examined in terms of their visual design. Ease of perception and understanding of the message presented on the websites carry utmost importance for online learners. This fact necessitates the analysis of text readability and legibility for the information transfer. In addition to applying the available readability formulas, this study contributes to the literature in showing the relationship between the two measurements by examining the physical properties of the texts using the text design elements scale.

Literature

It is necessary for the information on the web pages to reach a wider audience, to be easy to read and understood, and for the webpages to be universally accessible (Ojha et al., 2021). Ali et al. (2013) report the tendency of readers to prefer online materials rather than in print media, and web designers should take this into account. Although there is no written list of design rules that educational websites must comply with; many agreed upon and recommended design principles and guidelines are available. Web designers choose whether to abide by these principles and guidelines. Nevertheless, the designers need to consider these principles and guidelines to attract more audience.

Miniukovich et al. (2017) states that readability is an under-researched aspect of user experience and that very few websites are designed for high readability. They point out the issues with the available readability guidelines. For this reason, as an outcome of their workshops with design and dyslexia experts; they have developed a satisfactory readability directive to be kept in mind during the designing process.

Although many formulas (such as Flesch Reading Ease Formula, Flesch-Kincaid Grade Level Formula, Gunning Fog Index, Coleman-Liau Index, SMOG Index etc.) have been developed and studies have been carried out for the readability evaluation of traditional texts, web readability still arouses the curiosity of researchers. Research has concentrated on the accessibility, readability and site ranking of websites using different accessibility and readability assessment tools (Ismail et al., 2019; Ismail & Kuppusamy, 2016; Ojha et al., 2018). Additional features have been taken into account for readability classification. For instance, Bennör (2005) and Newbold et. al. (2010) created new readability formulas for this purpose (Vajjala & Meurers, 2013). Vajjala and Meurers (2013) investigated how these readability models perform on web texts with newly added features. They applied their readability models to web search results and identified a relatively high level of online reading.

Ojha et al. (2021) presents an analysis of various readability measurement techniques in their study. They set four goals to analyze, compare and define the attributes of readability indices especially when accessed by people with disabilities. As a result,

they offer useful suggestions that the effectiveness could be enhanced if they are considered while developing the readability formulas.

In the study of Antunes and Lopez (2019) the readability of web pages is analyzed according to the related topics and their position in the search result. Having collected the first twenty Google search results on twenty topics, they tested the results using the readability criteria. The analysis shows that content provided by institutions such as universities, and health-related content have lower readability values. In another research, Bilal and Huang (2019) analyzed the readability and word complexity of two different search engine result pages; and found a significant difference between the results of search engines in terms of page readability and word complexity. The readability of search engine results is significantly higher than the associated web pages. In addition, readability of Google search results is found to be much higher than that of Bing search results.

Martin and Gottron (2012) analyze how to reliably measure the readability of web documents. They explore web-based corpus statistics as an alternative to measure readability independent from the language and indicate that corpus statistics can further be exploited for readability. It is seen that the distribution of terms into frequency classes accurately generates the perceived difficulty of text categories. In another study, Hall and Hanna (2004) examine the effect of web page text/background color combination on readability, memorability, aesthetics, and behavioral intent. 136 participants evaluated two websites, one with educational content and one with commercial content, based on the four color combination conditions. The results display that colors with higher contrast ratios are generally more readable; and, color combination significantly affects permanence. Further, it is reported that preferred colors lead to higher scores on aesthetic quality and intent of purchase; and aesthetic quality ratings significantly relate to the intent of purchase.

Hussain et al. (2011) explore ways of presenting the websites according to the different age groups in terms of readability and usefulness. The study focused on eight readability factors such as color contrast, white space, line spacing, font style, font size, text width, headings, graphics, and animation. By modifying these eight factors, the reaction of different age groups was compared. Readability for each group was influenced by different factors including color contrast, white space, font style and size, text width and title, graphics and animation, intelligibility of content, vocabulary, and text congestion. The study by Kadayat and Eika (2020) investigate the effect of sentence length on the readability of web texts accessed using screen readers such as those used by the the visually impaired. It is concluded that web content providers should prefer 16-20 word sentence lengths to maximize readability.

The literature presents suggestions and solutions to enhance the readability of online content. Yu and Miller (2010) propose a format called Jenga to increase the readability of web pages. Their study with 30 Asian users with intermediate English fluency aim to evaluate the Jenga Format and show that the proposed conversion method improved reading comprehension without any adverse effect on the reading speed.

Web content has been read in a variety of domains. Significantly, patients and caregivers are increasingly referring to the internet as a source of medical information. Internet stands out as one of the primary sources that people consult in any health-related issue. However, poor health literacy often limits the patient's understanding of the health care information literature (Sharma et al., 2014). Print and web-based materials are widely used to support patient education due to their ease of distribution, accessibility, and low cost; however, their effectiveness may be limited if they cannot be read or comprehended (Tian et al., 2014). For this reason, numerous studies have focused on the readability of websites used in the field of medicine (D'Alessandro et al., 2001; Friedman & Hoffman-Goetz, 2006; Georgsson & Carlsson, 2020; Hanley et al., 2019; Klonaris et al., 2020; Lim et al., 2021; Sabharwal et al., 2008; Tian et al., 2014). These studies clearly illustrate the significant role and function of readability in websites and call for designer to consider.

METHOD

This study aims to examine educational websites in terms of their text design and readability and uses the scanning model. The purpose of survey research is to describe by holistically analyzing an existing situation related to the research subject. In addition, survey type studies allow examining the relationships between the variables measured (Büyüköztürk et al., 20019).

The study population of this research consists of websites with educational content for primary school students, published in Turkish. The educational websites were listed using Google search engine as a popular and reliable search engine utilizing advanced techniques (Gürdağ & Özturan, 2002). The search results were ordered using an algorithm called PageRank (Brin & Page, 1998). As a result of the keyword searches such as "educational content websites, educational sites, lectures, online courses, course sites, distance education, teacher sites, online learning, children's sites" a variety of websites were accessed. The researchers aimed to reach a wide universe by branching the search with connections. Among the sites accessed, 10 sites that convey an educational content or a topic to users were included in the research and formed the sample of the research. Among the sites accessed with keyword search, sites that do not offer any educational content and lectures or correspond to the courses taught in primary and secondary education, although they are education related, were excluded from the research.

Data Collection

For data collection purposes, the formula that Ateşman (1997) had adapted from Flesch Kincaid's readability formula into Turkish was used to determine the readability level of the texts on the websites.

In the scale development process, first, the types of forms the texts are found on the webpages were determined. The texts on the web pages were grouped as headings, lists, links, and content. While determining the scale items, the physical features of the text such as headings, lists, links, typographic elements of the content, design principles were considered. The scale developed by Alpan (2004) significantly guided the "Website Text Design Elements Evaluation Scale" developed within the research. The scale items from Alpan's (2004) study are mostly related to the typographical features of the text. The Website Text Design Elements Evaluation Scale was prepared in the form of a 5-point rating scale. Items in the scale were scored as (5) Completely appropriate, (4) Appropriate, (3) Undecided, (2) Not suitable, (1) Not at all suitable.

In the Turkish version of the Flesch readability formula, adapted to Turkish by Ateşman, the following readability formula and classification, which is based on word and sentence length and can be applied in a section of one hundred words selected from the text, has been developed:

Readability Count= 198,825 – 40,175 x1 – 2,610 x2

x1 = Average word length in terms of syllables

x2 = Average sentence length in terms of words

The formula score is evaluated according to the Turkish readability ranges. These ranges are defined as "Very Easy" for 90-100 points, "Easy" for 70-89, "Average" for 50-69, "Difficult" for 30-49, "Very Difficult" for 1-29 points.

Analysis of Data

In the evaluation of educational websites in terms of text design; the correlation between the scores given by the experts for each site was examined. Having determined the correlation between the expert ratings as high, the scores given by the two experts for the sites were averaged.

During the expert evaluation, if the items such as tables, lists, and text boxes, which were evaluated in the scale items, were not found on the site; the scale item was excluded, and the score was calculated according to the number of items examined. After the scoring was completed, the scores given to each item of the scale were summed up and averaged. The scores obtained from the scale were calculated as a percentage to develop a common scoring in sites with varying number of items evaluated. The scores obtained as a result of the scale are evaluated out of 100.

Table 1. Text Design Legibility Range

Level	Readability Score
Very easy	90-100
Easy	70-89
Average	50-69
Difficult	30-49
Very difficult	1-29

The scores of educational websites from the scale were evaluated according to the Text Design Legibility Range (see Table 1). To determine the readability level of educational websites within the sample, the length of words and sentences was calculated in a 100-word section selected from a text on the site. These values were substituted in the readability formula (Readability number = 198,825 – (40.175x1 – 2,610x2)) and multiplied by the coefficients to calculate the readability values of the site. In the selection of online text, items containing text such as lists, poems, tables were excluded from the scope of the research. The t test was used to analyze whether there was a significant difference between the value from the scale evaluation of the sites and the readability value obtained from the readability formula.

FINDINGS

Descriptive results from the scales and procedural results regarding the research questions are presented respectively. Table 2 demonstrates the average scores of each item from the observer evaluation according to the text design elements of the websites.

$\overline{X}$n: The item average score for each site.

$\overline{\overline{X}}$: The average of the average scores the items received from the sites.

$$\overline{\overline{X}} = \frac{\overline{X}^{+} \quad \overline{X}^{+} \quad \overline{X}^{+} \cdots \quad \overline{X}}{n}$$

Table 2. Mean Scores of Scale Items from Observers

Scale items Number	$\overline{X}1$	$\overline{X}2$	$\overline{X}3$	$\overline{X}4$	$\overline{X}5$	$\overline{X}6$	$\overline{X}7$	$\overline{X}8$	$\overline{X}9$	$\overline{X}10$	$\overline{\overline{X}}$
1	4,0	2,0	1,0	2,0	2,0	2,5	4,0	3,5	3,5	3,5	2,80
2	5,0	5,0	5,0	2,0	1,0	4,0	4,5	2,0	3,5	2,5	3,45
3	5,0	1,0	5,0	4,0	3,0	5,0	3,5	3,5	3,5	3,5	3,70
4	5,0	5,0	2,0	2,0	2,5	4,0	4,0	5,0	2,5	2,0	3,40
5	5,0	2,0	5,0	5,0	2,5	4,0	4,5	4,5	3,0	4,0	3,95
6	5,0	4,0	5,0	5,0	3,5	5,0	4,5	4,5	5,0	4,0	**4,55**
7	5,0	5,0	4,0	5,0	2,0	4,0	4,5	5,0	2,5	4,0	**4,10**
8	-	4,0	4,0	2,5	1,0	5,0	-	1,0	5,0	2,5	3,12
9	4,0	5,0	5,0	5,0	4,0	4,0	4,5	4,0	3,5	3,5	**4,25**
11	5,0	5,0	5,0	5,0	4,5	5,0	4,5	4,5	4,0	4,5	**4,70**
12	5,0	5,0	5,0	4,5	4,0	4,0	5,0	4,0	4,5	5,0	**4,60**
13	-	5,0	5,0	4,0	5,0	5,0	3,0	1,5	4,5	2,0	3,88
14	1,0	5,0	1,0	1,0	1,0	1,0	2,0	1,0	1,0	1,0	1,50
15	-	4,0	-	-	-	-	1,0	-	-	-	2,50
16	1,0	1,0	1,0	1,0	1,0	1,0	2,5	1,0	1,0	1,0	1,15
17	1,5	1,0	1,0	1,0	1,0	1,0	2,0	2,0	1,0	1,0	1,25
18	4,0	4,0	5,0	5,0	5,0	5,0	5,0	4,0	2,0	2,5	**4,15**
19	5,0	5,0	4,0	5,0	4,0	5,0	5,0	5,0	3,0	3,5	**4,45**
20	5,0	2,0	4,0	2,5	4,5	5,0	3,5	3,5	1,5	1,0	3,25
21	5,0	4,0	5,0	4,5	3,5	5,0	5,0	5,0	5,0	4,0	**4,60**
22	2,0	1,5	4,0	1,5	2,0	5,0	4,0	2,5	3,5	4,5	3,05
23	4,0	4,0	4,0	-	4,5	5,0	5,0	4,5	2,5	4,5	**4,22**
24	-	-	5,0	-	1,0	5,0	-	-	-	-	3,66
25	5,0	2,0	5,0	4,0	4,5	5,0	5,0	5,0	4,5	4,0	**4,40**
26	2,0	2,0	5,0	4,0	4,0	5,0	5,0	4,5	1,0	1,0	3,35
27	5,0	2,0	5,0	1,0	3,5	5,0	4,0	5,0	1,5	2,5	3,45
28	4,5	2,0	5,0	1,0	5,0	5,0	4,5	5,0	2,0	1,0	3,50
29	5,0	4,0	5,0	1,0	3,5	5,0	5,0	5,0	4,5	5,0	**4,30**
30	5,0	4,0	5,0	5,0	5,0	2,5	5,0	5,0	4,0	5,0	**4,55**
31	4,0	1,0	2,0	5,0	3,5	1,5	4,0	1,0	2,0	1,0	2,50
32	4,5	1,0	2,0	3,0	2,0	3,5	4,0	4,5	4,5	3,5	3,25
33	5,0	5,0	4,0	4,5	4,5	5,0	5,0	4,5	5,0	4,0	**4,65**
34	1,0	1,0	1,0	1,0	1,0	1,0	5,0	2,5	1,0	1,0	1,55
35	4,0	5,0	5,0	5,0	3,5	5,0	5,0	5,0	5,0	4,0	**4,65**
36	2,0	5,0	5,0	5,0	4,5	5,0	5,0	5,0	5,0	5,0	**4,65**
37	1,5	1,0	1,0	4,0	1,0	5,0	5,0	2,5	2,5	1,5	2,50
38	-	-	5,0	-	-	1,0	1,0	-	-	-	2,33
39	1,0	4,0	5,0	1,0	4,5	1,0	5,0	5,0	4,5	1,0	3,20
40	4,5	5,0	1,0	5,0	2,0	5,0	5,0	4,0	2,0	1,5	3,50
41	5,0	5,0	5,0	3,5	4,5	5,0	5,0	4,5	1,0	1,5	**4,00**
42	5,0	5,0	1,0	5,0	2,0	5,0	5,0	5,0	1,0	4,0	3,80
43	5,0	5,0	1,0	1,0	1,0	1,0	2,0	1,0	1,0	1,0	1,90
44	2,0	5,0	-	-	1,0	-	5,0	4,5	1,0	-	3,08
45	4,0	2,0	5,0	5,0	5,0	4,0	5,0	4,0	5,0	4,5	**4,35**
46	5,0	4,0	5,0	4,5	4,0	5,0	5,0	5,0	5,0	4,0	**4,65**
47	5,0	1,0	5,0	2,0	3,5	4,5	5,0	4,0	5,0	3,5	3,85
48	1,0	1,0	1,0	1,0	1,0	2,0	1,0	1,0	1,0	1,0	1,10
49	5,0	4,0	5,0	4,0	5,0	5,0	5,0	5,0	5,0	5,0	**4,80**
50	5,0	2,0	4,0	2,0	1,5	3,5	5,0	4,0	4,0	4,5	3,55
51	5,0	5,0	5,0	4,0	4,0	4,0	5,0	2,5	1,5	4,0	**4,00**
52	4,5	2,0	4,0	4,0	3,5	2,5	5,0	4,5	4,0	5,0	3,90
53	4,5	5,0	5,0	2,0	5,0	5,0	5,0	5,0	5,0	1,0	**4,25**
54	1,0	1,0	1,0	1,0	1,0	5,0	5,0	1,0	1,0	1,0	1,80
55	5,0	2,0	2,0	1,0	1,0	1,0	4,0	4,0	1,0	1,0	2,20

The 6, 11, 12, 18, 19, 21, 23, 25, 29, 30, 33, 35, 36, 41, 45, 46, 49, 51, and 53rd items of the scale items on the websites were evaluated according to Table 2. Overall, it scored more than 4.0 points (items with a score above 4 are indicated in bold). It can be said that the text design elements in these items were considered in the websites. For example, the average score of items 49 from the scale as a result of expert evaluation is 4.80. Hence, it can be interpreted that the criterion of "A topic or idea is mentioned in each paragraph" mentioned in item 49 on the websites is mostly complied with in all websites. According to Table 2, items 14, 15, 16, 17, 31, 34, 37, 38, 43, 48, 54 and 55 were scored below 2.5 points (in the table, items scored below are in italics). In the websites, text design elements in these items seem to be the least considered features. Table, 2 demonstrates that the item with the lowest score is item 48. It can be concluded that the criterion of "putting the result at the beginning (Inverted Pyramid)" mentioned in item 48 in the websites is an overlooked criterion.

Findings of Research Question 1:

"What are the difficulty levels of the texts on educational websites according to the scale of text design elements?"

The correlation between the scores of the websites on the text design elements evaluation scale and the expert scores was tabulated, evaluated, and interpreted in a comparative way. Table 3 presents the number of items included in the evaluation of each site.

Table 3. The Scores of the Websites for Text Design as a Result of the Text Design Scale

Site Number	r	P	Item number	Score	Scale Level
1	,969	,00	50	79,00	Easy
2	,997	,00	53	66,98	Average
3	,997	,00	52	75,19	Average
4	,957	,00	50	66,00	Average
5	,905	,00	53	60,18	Difficult
6	,973	,00	53	77,16	Average
7	,855	,00	53	85,28	Easy
8	,882	,00	52	73,20	Average
9	,916	,00	52	61,73	Difficult
10	,924	,00	51	58,82	Difficult

Table 3 shows a high level and significant relationship between the results of the evaluations made by the observers according to the developed scale.

Findings of Research Question 2:

"What are the readability levels of the texts on educational websites according to the result obtained from the readability formula?"

To determine the readability levels of the texts on the sites, Ateşman's (1997) readability formula was applied to the texts and the data on the readability are given in Table 4.

The results obtained from Ateşman's (1997) readability formula were interpreted according to Table 4. It is found that only the texts in the first and seventh websites are easily readable, 4 sites are of average difficulty, 2 sites are difficult, and the texts in 1 site are very difficult in terms of readability.

Table 4. Educational Websites Readability Level

Site Number	Readability Formula Score	Readability Level
1	73,89	Easy readable
2	55,09	Average readable
3	60,12	Average readable
4	48,47	Difficult readable
5	43,86	Difficult readable
6	49,82	Average readable
7	70,66	Easy readable
8	21,91	Very difficult readable
9	53,41	Average readable
10	8,18	Very difficult readable

Findings of Research Question 3:

"Is there a significant relationship between the readability level determined by the readability formulas of the websites and the levels determined by the text design elements scale?"

Table 5. Scale values and readability formula values

Site Number	Scale Score	Scale Level	Readability Formula Score	Readability Level
1	79,00	Easy	73,89	Easy readable
2	66,98	Medium	55,09	Average readable
3	75,19	Medium	60,12	Average readable
4	66,00	Medium	48,47	Difficult readable
5	60,18	Difficult	43,86	Difficult readable
6	77,16	Medium	49,82	Average readable
7	85,28	Easy	70,66	Easy readable
8	73,20	Medium	21,91	Very difficult readable
9	61,73	Difficult	53,41	Average readable
10	58,82	Difficult	8,18	Very difficult readable

After the scale evaluation and readability formula evaluation of the websites, the readability levels were determined according to the results of two evaluations. Table 5 shows the scores and levels of the sites from the text design scale and the readability formula.

As a result of the scores obtained from the scale and the readability formula, the text design levels, and readability levels of the sites were identified, and comparative data is presented in Table 5. According to the results of the evaluations, the scores from the scale and the determined levels of the sites, and the scores and readability levels from the readability formula are similar. The difference in the readability level and the levels corresponding to the score from the scale in some sites might be because of the evaluation of scale on a 3-point rating and the evaluation of readability level on a 5-point rating. However, when the levels of the sites are compared, a site that is identified as very difficult is not easy in the text design scale or easy in the formula, but not difficult in the text design scale. According to the data, the frequencies and percentages of the sites identified as Easy, Average or Difficult in terms of readability are given in Table 6.

Table 6. Frequency and percentage of readability and text design levels of websites

Level	f	%
Easy	2	20
Average	5	50
Difficult	3	30

Data in Table 6 present significant information on the readability and text design levels of the websites published in Turkey. Among the 10 sites evaluated, 20% (n=2) of the sites can be described as easy, 50% (n=5) of the sites as average level, and 30% (n=3) as difficult to read. These frequencies and the data might be generalized as 20% of the websites published in Turkey can be described as easy in terms of readability, 50% as medium difficulty and 30% as difficult.

DISCUSSION

Given the high usage of web content, it is important to analyze its readability (Antunes & Lopez, 2019). The Internet has emerged as a widely used and significant platform for conveying information between various locations. In order to ensure information is available to everyone, it's crucial to assess both its accessibility and readability score (Ojha et al., 2021). This study aims to reveal the relationship between the text design elements of educational websites and their readability levels, the data on the text design elements scale and readability levels of the texts on the educational websites. The conclusions reached based on these findings are as follows:

The most important features in terms of text design elements in the educational websites are found as the tone value of the text that makes it easier to read, the balanced use of the spaces between the letters, the attention to the integrity of the text on the page, the listing levels not exceeding two levels, and the clickability of the links. It is important for web-based instructional designers to choose the appropriate font for especially long text blocks to enhance students' readability levels (Ali et al., 2013). The least considered features in terms of text design elements in the educational web sites are seen as arrangement of glossary and bibliography, exclusion of scroll bars, explanation of links with texts, identification of visited links, inverted pyramid technique, and the use of in-page hyperlinks. The texts on the educational websites are identified at a medium difficulty level according to the text design elements scale. According to the result from the readability formula, the readability levels are observed at the medium difficulty level. Similarly, in their study conducted in the field of health, McCarthy & Flavin (2021) categorized 16.6% of the websites they evaluated in terms of readability as "easily readable" and most of them as "difficult to read." assess both accessibility and readability of online educational materials. At the same time, in a study conducted by Schreidah, Fahmy, Lapolla, Gordon, Kwinta, and Geskin (2023) evaluating the accessibility and readability of online educational materials, it was found that the readability levels of academic web pages were higher compared to non-academic web pages.

CONCLUSION AND RECOMMENDATIONS

Based on these findings a similarity between the readability level of the websites and the levels identified through the evaluation of the text design elements. Accordingly, the design elements of the text, namely the physical properties, the quantitative features such as the number of words and syllables need consideration while evaluating the readability of websites. The readability of a webpage is not limited to either the physical properties of the text or the quantitative formulas; both of these features need a close analysis.

Within the framework of the results, the suggestions for future studies on the website design and evaluation are as follows:

- The values from the readability formulas give information about the quantitative properties of the texts, but not about their qualities. While investigating the readability level of a website; a joint evaluation with two measurements, comments about the readability referring to the readability formulas, and a scale for identifying the qualitative features of the text necessitate.
- The readability levels were identified by analyzing the first 100 words on a page on the website. Future studies are recommended to increase the number of words or analyze the whole web content.
- This study was limited to the websites for primary and secondary school students. The research can be extended to educational websites for tertiary level education.
- Teachers can benefit from the text design scale and the readability formula in the selection of appropriate sites when recommending or using sites as an additional resource for their students.
- In addition to researchers, website designers can evaluate the texts by using the scale and readability formulas developed within the scope of this research.

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Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Examples of author contribution statements

We confirm that this work is original and has not been published elsewhere, nor is it currently under consideration for publication elsewhere. The authors confirm contribution to the paper as follows: study conception and design: Fatma Keskinkılıç and Serçin Karataş. Data collection, analysis and interpretation of results: Fatma Keskinkılıç. Draft manuscript preparation: Fatma Keskinkılıç. Serçin Karataş encouraged Fatma Keskinkılıç to supervised the findings of this work. All authors discussed the results and contributed to the final manuscript.

Researchers' contribution rate

The study was conducted and reported with equal collaboration of the researchers.

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