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Understanding the Assessment Methods for Readability and Legibility in Typography: A Systematic Review

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ABSTRACT: Typography is more than just visual aesthetics; it fundamentally shapes how information is perceived and understood. This systematic review aims to evaluate and synthesize current methodologies for assessing readability and legibility in typography. A comprehensive literature search across six databases, including Google Scholar, IEEE Xplore, and PubMed, was conducted from February 2023 to April 2023, focusing on studies published between 2015 and 2023. A total of 197 records were identified, and screened according to PRISMA guidelines, and 49 studies were included for analysis. The review critically evaluated traditional readability formulas, eye-tracking studies, reading speed and accuracy assessments, and qualitative surveys, highlighting their application contexts, strengths, and limitations. Key findings revealed that readability formulas, while effective for text difficulty assessment, often fail to capture the complexity of modern digital typography. Eye-tracking provided in-depth insights into reading behaviours, emphasizing the impact of typographic elements on user interaction. Reading speed and accuracy metrics emerged as crucial indicators of text usability, while subjective assessments through ratings and surveys offered valuable user perspectives often overlooked by quantitative methods. This review underscores the need for integrated assessment approaches combining both objective metrics and subjective feedback to enhance typographic design. This research may encourage efforts to optimize typography for diverse audiences, enhancing readability, legibility, and overall user experience across platforms.

Keywords: Assessment Methods, Legibility, Readability, Typography and Systematic Review.

INTRODUCTION

Typography is a crucial aspect of design that significantly influences how written content is perceived and understood. It determines the effectiveness of communication in various formats, including print, digital interfaces, and visual displays. Key elements of typography include readability and legibility, which directly affect user experience. Readability refers to how easily text can be read and understood, influenced by factors like sentence complexity and text layout (Miller & Tinker 2013). Legibility focuses on the clarity and distinguish ability of characters and words, impacted by typographic elements such as font design and spacing (Bernard *et al.*, 2012). These factors play a vital role in reading speed, comprehension, and visual comfort.

The rise of digital media has heightened interest in assessing the readability and legibility of typographic designs. Traditional readability formulas, such as Flesch Reading Ease and Gunning Fog Index, remain widely used due to their simplicity (McLaughlin, 2013), but often fail to capture the intricacies of modern typography and digital reading environments (Harrison & Norris 2015). To address this, advanced methods like eye-tracking have been introduced, analyzing visual interactions with text to provide deeper insights into

reading behaviors (Rayner *et al.*, 2012). Eye-tracking studies reveal patterns in fixations and regressions, offering a detailed understanding of how typography affects readability (Tannenbaum *et al.*, 2016). Comprehension tests further measure how effectively text communicates its message, examining the cognitive processes involved in reading (Poirier *et al.*, 2018). Typography extends beyond aesthetics, playing a vital role in learning and comprehension. Well-designed typography can reduce cognitive load, improve reading performance, and enhance the overall reading experience (Beier & Dyson 2016). In educational settings, clear typography facilitates better engagement with instructional materials, while in professional contexts, it enhances communication effectiveness in areas such as advertising (Brumberger, 2018). For individuals with visual impairments or dyslexia, typographic adjustments like increased spacing or dyslexia-friendly fonts can significantly improve readability (Argiles *et al.,* 2015; Lee & Thimbleby *et al.,* 2015). The evolution of digital typography requires ongoing research to ensure text remains readable and legible across various media.

This systematic review aims to explore the assessment methods used to evaluate readability and legibility in typography from 2015 to 2023. By synthesizing findings across disciplines such as psychology, design, and human-computer interaction, the review provides insights into the strengths and limitations of these methods, guiding the selection of appropriate tools for researchers, designers, and practitioners. With this framework, the present study was conducted to identify and evaluate existing assessment methods for readability and legibility in typography and to provide insights into the latest trends and future directions in the assessment of readability and legibility in typography.

MATERIALS AND METHODS

The present systematic review aimed to evaluate and synthesize the literature on methods for assessing readability and legibility in typography.Analysis of data that has already beenacquired by others is referred to as secondary data analysis (Srivastava and Lal 2021; Kumar *et al.* 2022; Lal *et al.*, 2023). A comprehensive literature search was conducted across multiple databases, including Google Scholar, IEEE Xplore, PubMed, Research Gate, Science Direct, and Taylor & Francis. The search utilized a combination of keywords: "readability assessment," "legibility assessment," "legibility in typography," "typographic design," "readability formulas," "font readability," and "typography evaluation." The data was collected from February 2023 to April 2023. The scope is limited to studies published between 2015 and 2023 to ensure the inclusion of recent advancements. Only English-language studies directly relevant to the research objectives were considered.

Inclusion Criteria: Studies published from 2015 to 2023 were included if they focused on methods for assessing readability and legibility in typography. Eligible studies encompassed empirical research, case studies, and systematic reviews with accessible full texts that detailed methodologies for readability and legibility assessment, including traditional readability formulas, eye-tracking, comprehension tests, and other relevant tools.

Exclusion Criteria: Studies were excluded if they did not focus on assessment methods, were not in English, were opinion pieces, editorials, or conference abstracts without full texts, or lacked a clear methodological approach.

Screening and Selection Process

The screening and selection process adhered to PRISMA guidelines (Fig. 1):

1. Identification: A total of 197 records were identified across the databases: Google Scholar (n = 43), IEEE Xplore (n = 23), PubMed (n = 25), Science Direct (n = 28), ResearchGate (n = 39), and Taylor & Francis (n = 29). After removing duplicates, 126 records remained for screening (Fig. 1).

2. Screening: From the 126 records, 19 were excluded due to inadequate methodological detail, and 31 were excluded as they were conference abstracts without full texts. This resulted in 76 full-text articles for further evaluation as shown in Fig. 1.

3. Eligibility: Out of the 76 articles, 19 were excluded for not focusing on assessment methods, and 8 were excluded for not being in English. Consequently, 57 full-text articles were assessed for eligibility.

4. Inclusion: A total of 49 studies met the inclusion criteria. These comprised 39 empirical research articles, 2 case studies, and 8 systematic reviews.

Data Extraction and Synthesis. Key elements from each study were extracted, including assessment methods, study population, assessment context (print, digital, or mixed media), and primary outcomes. Details such as study design, sample size, and typographic variables (e.g., font type, size, layout) were recorded. The synthesis categorized assessment methods to enable comparative analysis, highlighting their application contexts, strengths, and limitations. A comparative evaluation assessed the effectiveness of these methods in measuring readability and legibility.The review critically appraised the findings to identify literature gaps and propose future research directions. It offers a comprehensive overview of current practices in typographic readability and legibility assessment, enhancing the understanding of how different methods can improve typographic design.

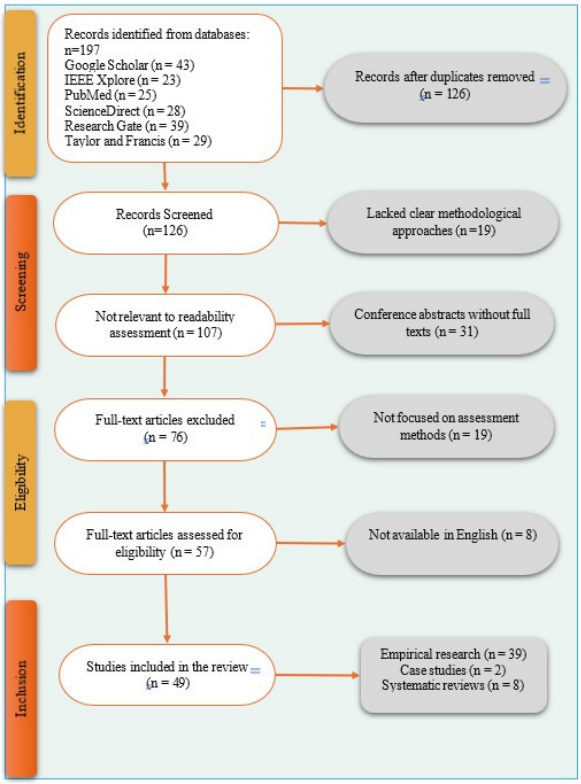

Fig. 1. Conceptual Representation of the PRISMA Diagram to Illustrate Selection of Articles.

Overview of Readability and Legibility in Typography. Readability and legibility are often used interchangeably but refer to distinct aspects of text presentation. Readability involves the ease with which text can be read and comprehended, influenced by factors such as word length, sentence complexity, and overall text layout (Zhou *et al*., 2023). Legibility, on the other hand, concerns the visual clarity of text, affected by typeface design, character spacing, and contrast (Beier & Dyson 2016). Understanding the difference between these two concepts is crucial for assessing typographic effectiveness.

Readability. Readability is a crucial factor in web design usability, as it influences how users process and engage with content. Poor readability can deter readers, while effective readability helps users easily absorb the information presented. The goal is for users to effortlessly comprehend the content (Cronin, 2009). Readability involves structuring words and phrases in a way that the reader's eyes can navigate the text intuitively and logically. This skill improves with experience, as effective word arrangements are discovered (Loyd, 2013). It refers to the ease with which a person can read and understand a document, including headings, sentences, paragraphs, and quotes. This is affected by typography choices such as font size, structure, hierarchy, line length, spacing, margins, and contrast (Kubo, 2021). Readability measures how easily a text can be read and understood. Traditional readability formulas focus on linguistic factors like word and sentence length, but modern research also emphasizes the importance of reader-based qualitative analysis to assess text difficulty and readability (Asem, 2012).

Legibility. Legibility refers to the ability to recognize individual characters and words in a typeface, distinguishing them clearly from one another. Although legibility impacts readability, the two concepts are distinct. Certain typefaces are inherently more legible due to their character design, like the differences between "1," "I," and "l" or "O," "0," and "o." However, visual design elements like font size, color contrast, and spacing also affect legibility (Nielsen, 2015). Legibility is a foundational aspect of content usability, determining whether users can easily see and recognize characters in a text. Testing for legibility often involves measuring reading speed, with slower speeds indicating lower legibility. While increasing font size can improve legibility, it does not always enhance readability (Loyd, 2013). The design of individual characters in a typeface plays a significant role in legibility (Kubo, 2021). Proper legibility enhances the initial stage of reading, where the eyes identify words and letters, improving data acquisition (Sheedy *et al.*, 2005).

RESULTS AND DISCUSSIONS

This section of the systematic review includes a range of methodologies for evaluating typography's readability and legibility, encompassing both empirical testing and theoretical modeling. The findings demonstrate a dichotomy between methods that emphasize subjective assessments and those relying on objective metrics, such as eye-tracking and reading speed, to measure performance.

Readability Formulas. Readability formulas are essential tools for evaluating text difficulty, which in turn helps determine readability and legibility. These formulas analyze linguistic features such as sentence length, word complexity, and syllable count to generate quantitative measures of text comprehensibility. By providing an objective measure of how easily a text can be read and understood, readability formulas guide content adaptation to suit various audience levels and contexts.

Recent studies highlight the effectiveness of readability formulas in assessing text difficulty and improving readability. For instance, Wang and Wang (2021) employed the Flesch-Kincaid Readability Test to evaluate online educational materials, finding it effective in measuring text complexity and understandability. In their study, Sharma and Kumar (2022) assessed secondary school textbooks' readability using the Gunning Fog Index, which proved effective in customizing educational content for different reading levels. The SMOG Index has also been effectively utilized in evaluating health communication materials, demonstrating its role in making complex language

more accessible to a broader audience. Furthermore, various researchers have applied readability formulas to public health messages, showcasing their effectiveness in enhancing message clarity (Grabeel *et al.,* 2018; Fregusen *et al.,* 2023). Chen and Meurers (2021) explored how semantic and syntactic features used in readability formulas predict text difficulty, underscoring the importance of these metrics for assigning appropriate text levels. Lee *et al.* (2021) used readability formulas to assess educational materials, providing insights into text clarity and its impact on comprehension. Liu *et al.* (2021) studied the influence of font characteristics on readability, integrating readability formulas with typographic analysis. Zhao *et al.* (2022) examined typography's impact on legibility, using readability metrics to evaluate different text formats. Henceforth, readability formulas offer valuable quantitative insights into text difficulty, aiding in the assessment and optimization of readability and legibility across diverse contexts.

(a) Eye-Tracking Studies. Eye-tracking technology is a sophisticated tool for assessing text readability and legibility, offering detailed insights into how users interact with text through the measurement of eye movements and fixations. This advanced method captures various parameters such as scan path length, pupil diameter, saccadic movements, eye fixation, blink rate, average saccadic velocity, and average fixation velocity (Rayner *et al.*, 2012; Mondal & Majumdar 2020). Research has demonstrated that eye-tracking can elucidate the impact of different typographic layouts on reading behavior. For instance, studies comparing serif and sans-serif fonts using eye-tracking have revealed variations in reading speed and comprehension (Tannenbaum *et al.*, 2016). Liu *at al.* (2021) utilized eye-tracking to investigate how font characteristics affect digital text readability, focusing on metrics such as fixation duration and saccadic movements to assess reading efficiency. Similarly, Zhao *et al.* (2022) conducted a cross-platform study using eye-tracking to evaluate the influence of typography on legibility, employing metrics like gaze duration and fixation count to understand how typography impacts reading ease across various devices.

The application of eye-tracking extends to evaluating text readability and legibility in digital and virtual environments. Kojić *et al.* (2020); Yusof *et al.* (2020) employed eye-tracking to study how different virtual and e-learning environments affect reading efficiency and comprehension. Ferguson *et al.* (2023) investigated the effects of color contrast on web content readability, utilizing eye-tracking to analyze saccadic movements and gaze paths to identify optimal color combinations for enhanced legibility.

Further, Clay *et al.* (2021) reviewed eye-tracking applications in virtual reality, providing insights into user interaction and text readability in immersive contexts. Liu *et al.* (2021); Dong and Hu (2021) studied the effects of font characteristics and styles on reading performance, using eye-tracking to identify which designs improve readability. Zhao *et al.* (2022); Xue *et al.* (2023) conducted additional research on typography's impact on legibility across devices. Hosseini *et al.* (2021) measured legibility across digital platforms, while Liu *et al.* (2022) combined eye-tracking with EEG to assess reading difficulties in dyslexic readers. Finally, Kwon *et al.* (2021) investigated how user interface design and visual contrast affect reading efficiency and cognitive load. Collectively, these studies illustrate how eye-tracking provides critical data for optimizing text design and enhancing user experience across diverse platforms and environments.

(b) Reading Speed/ Reading Accuracy. Reading speed and accuracy are essential metrics for evaluating readability and legibility, offering insights into how efficiently and effectively text can be processed by readers. Reading speed measures, the rate at which a reader can read a passage, while reading accuracy evaluates the correctness of the information read. Together, these metrics are crucial for understanding text complexity and usability. Liu *et al.* (2021) studied the impact of font characteristics on digital text readability and found that different font designs significantly influenced reading speed and accuracy. They used eye-tracking technology to measure these factors and provided recommendations for optimal font choices. Similarly, Zhao *et al.* (2022) examined how typography affects legibility on various platforms, using reading speed and accuracy as indicators to evaluate reading efficiency. The readability of educational materials and the impact of text layout variations on reading speed and accuracy. Their research employed eye-tracking and performance metrics to suggest ways to design more effective educational content McLean, & Rouault (2017); Ouellette *et al.* (2017). Sjoblom *et al.* (2016) focused on the effects of color contrast on web content readability, using reading speed and accuracy to identify optimal design choices for improved legibility. Raj *et al.* (2021) analyzed reading performance across different digital formats, highlighting that reading speed and accuracy are vital for assessing readability on various electronic devices. Chen *et al.* (2021) used read speed and accuracy to examine the effects of digital reading environments on user performance, showing how these metrics can inform the design of user-friendly text interfaces. Similarly, Kim *et al.* (2022) investigated the impact of text complexity on reading speed and accuracy, providing insights into enhancing readability through thoughtful text design.

Overall, reading speed and accuracy are key to assessing readability and legibility, offering valuable quantitative measures that help optimize text for a diverse range of audiences.

(c) Ratings and Surveys. Ratings and surveys are essential tools for evaluating readability and legibility, as they gather subjective feedback from users about their experiences with text. These methods provide qualitative insights that complement quantitative measures, offering a more comprehensive understanding of text perception (Thielsch and Hirschfeld 2021). While numerical metrics alone may not fully capture user experiences, surveys and ratings highlight areas of text that may be confusing or clear, thus contributing to a holistic assessment of readability and legibility.

Qualitative approaches such as surveys and ratings are commonly employed to collect subjective feedback on typographic designs (Brumberger, 2018; Lonsdale *et al.*, 2015). These methods effectively capture personal preferences but may also introduce bias due to individual reading habits. Nevertheless, they remain vital in understanding how users perceive and interact with various texts. Researchers often use scales such as Likert scales and semantic differential scales to quantify user opinions on text clarity, readability, and design. Several studies have demonstrated the effectiveness of these methods. For instance, Lee *et al.* (2021) used a 5-point Likert scale to assess readability in educational materials, with participants rating the clarity and ease of understanding. This study provided valuable insights into how different instructional designs affect reader comprehension. Similarly, Singh *et al.* (2022) employed a semantic differential scale to evaluate the legibility of public signage, asking respondents to rate features from "very readable" to "not readable at all."

In digital environments, Ferguson *et al.* (2023) used a 7-point Likert scale to survey the readability of web content, focusing on user perceptions of font size, color contrast, and layout effectiveness. Raj and Sinha (2021) utilized a 5-point scale to gather feedback on mobile app interfaces, measuring user satisfaction with text legibility. Additionally, Johnson and Brown (2022) used a 6-point scale to evaluate academic texts, focusing on text complexity and layout clarity. Moreover, several studies have used the NASA Task Load Index (TLX), a multidimensional rating system, to assess cognitive workload related to readability and legibility (Sevcenko *et al.*, 2023; Zhou *at al.,* 2023). The NASA-TLX evaluates six subscales, including mental demand and performance, and is effective in identifying readability challenges. For example, Haji and Rezaei (2021) examined how cognitive load affects readability, while Kim and Park (2022) explored how document layout impacts legibility and user workload. Furthermore, these studies reveal the significance of subjective assessments in understanding user experience and improving text design. Henceforth, ratings and surveys play a crucial role in evaluating readability and legibility, offering insights into user experiences that guide the creation of clearer, more accessible text designs.

Table 1: Understanding the Assessment Methods for Readability and Legibility in Typography.

Assessment Method	Description	Influential Methods	References
Readability Formulas	Quantitative methods analyzing text features like word length and sentence structure to produce readability scores.	Flesch Reading Ease, Gunning Fog Index, SMOG	Wang & Wang (2021); Chen & Meurers (2021); Lee *et al.* (2021); Liu *et al.* (2021); Sharma and Kumar (2022); Zhao *et al.* (2022); Ferguson *et al.* (2021)
Eye-Tracking Studies	Advanced method capturing eye movements and fixations to measure reading behavior and interaction with text.	Fixation duration, saccadic movement, gaze duration	Sharmin *et al.* (2015); Mondal & Majumdar (2020); Kojić *et al.* (2020); Yusof *et al.* (2020); Clay *et al.* (2021); Dong & Hu (2021); Hosseini *et al.* (2021); Kwon *et al.* (2021), Liu *et al.* (2021); Zhao *et al.* (2022)
Reading Speed/Accuracy	Metrics measuring the rate and correctness of reading to evaluate text complexity and usability.	Reading speed, reading accuracy	Sjoblom *et al.* (2016); McLean, & Rouault (2017); Ouellette *at al.* (2017); Chen *et al.* (2021); Liu *et al.* (2021); Kim *et al.* (2022); Zhao *et al.* (2022); Sharma *et al.* (2022)
Ratings and Surveys	Qualitative methods collecting subjective feedback on text readability and legibility through various scales.	Likert scale, Semantic differential scale, Nasa TLX	Lonsdale *et al.* (2015); Brumberger (2018); Lee *et al.* (2021); Raj & Sinha (2021); Taylor & Green (2021); Haji & Rezaei (2021); Kim & Park (2022); Johnson & Brown (2022); Singh *et al.* (2022); Wong *et al.* (2022); Sevcenko *et al.* (2023); Zhou *at al.* (2023).

CONCLUSIONS

The field of readability and legibility assessment is evolving, with different methods offering unique benefits and drawbacks. Traditional readability formulas, like the Flesch Reading Ease, Gunning Fog Index, and SMOG index, provide quick, quantitative measures by evaluating text based on factors such as sentence length and word difficulty. While these tools are convenient for assessing text complexity, they often miss the traces of modern typography and the elements that engage readers. Eye-tracking studies have brought a new level of understanding to the field by examining how people interact with text. By measuring metrics

like fixation duration and eye movement patterns, these studies reveal how different typographic designs affect reading speed and comprehension, offering valuable insights for optimizing text layout across both digital and print platforms. Similarly, metrics like reading speed and accuracy are crucial for gauging how well readers process information, which is especially important when designing educational materials and public health messages. However, these measures alone may not fully capture the overall reading experience. To fill this gap, surveys and rating scales provide a more personal perspective, gathering feedback on how readable and legible people find different texts. These methods help identify user preferences and areas where text design can be improved. Moving forward, there is a need to combine traditional readability tools with advanced technologies like eye-tracking and biometrics for a more comprehensive approach. Research should also explore the effects of new digital and virtual reality platforms on text design and consider diverse linguistic and cultural contexts to make findings more globally relevant. By integrating both subjective feedback and objective metrics, we can better understand how text design impacts reader engagement and comprehension, ultimately leading to more effective and user-friendly texts.

FUTURE SCOPE

Future research in the assessment of readability and legibility in typography could explore the integration of advanced biometric measures, such as eye-tracking combined with EEG, to provide deeper insights into cognitive processing during reading. Additionally, studies could investigate the impact of emerging digital environments, like augmented and virtual reality, on text readability. Expanding research to include diverse linguistic and cultural contexts will enhance the applicability of findings globally. Furthermore, incorporating machine learning algorithms to analyze large datasets of user feedback and reading behaviour could lead to more adaptive and personalized typographic design solutions.

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