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A Comparison Of Linguistic Complexity-Based Readability Methods In Educational Texts: Systematic Literature Review

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Abstract

This study aims to compare qualitative and quantitative methods used in linguistic complexity-based readability analysis of educational texts. The study employed a systematic literature review design following the PRISMA framework. A total of 500 records were identified from Google Scholar, then screened using inclusion and exclusion criteria covering publication year, document type, publication stage, journal quality, language, and open access availability. After screening titles, abstracts, and the eligibility of full texts, 20 studies were included for synthesis. The findings indicate that quantitative approaches dominate readability research, particularly through readability formulas, sentence length, word length, lexical density, cloze tests, and computational linguistic indicators. These methods are effective for producing objective and comparable readability scores, but they are limited in explaining semantic, discourse, and pedagogical contexts. Qualitative approaches are less common, yet they provide a deeper interpretation of text function, content relevance, and learner needs. Mixed-method approaches emerge as the most integrative option because they combine measurable linguistic indicators with contextual interpretation. The review suggests that future readability studies should integrate numerical assessment and pedagogical interpretation to produce more valid readability standards for educational texts.

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Keywords: readability; linguistic complexity; educational texts; qualitative method; quantitative method

INTRODUCTION

Indonesia has experienced a decline and lags far behind other countries, according to data from the Programme for International Student Assessment (PISA) 2018. In terms of reading literacy, Indonesia ranks 72nd out of 77 countries. PISA is an international program designed to assess the performance of secondary school students, particularly in the core subjects of science, mathematics, and literacy. Reading is the primary topic evaluated in PISA. According to PISA 2018, reading literacy is the ability to understand, use, evaluate, reflect on, and interact with texts to achieve goals, develop knowledge and potential, and make significant contributions to society.

The term readability or legibility means "easy to read," so it can be said that readability serves as a measure of whether a text is suitable for readers based on the level of difficulty or ease of the text (Abidin, 2012; Aliyah et al., 2024; Harjasudjana & Mulyati, 1997). Text readability in education is a critical issue in the learning process, as texts that are too easy can reduce cognitive challenges, while texts that are too difficult can hinder students' comprehension (Kusumaningtyas et al., 2025). Textbooks are used as tools to support the learning process and as a means for students to understand content and acquire specified skills (Chakraborty, 2021; Feng, 2022; Gooding, 2021; Kaushik, 2020). Regarding textbooks and learning materials, readability is not only related to sentence or word length but also to linguistic complexity, which includes lexical density, syntactic structure, coherence, genre, and the text's alignment with the reader's ability (Abdullah S et al., 2022). Therefore, readability standards should be understood as a multidimensional construct that integrates linguistic, reader, and learning context aspects.

Recent studies indicate that readability research is shifting from classical formulas toward more complex measurements. Readability formulas are still widely used because they are practical and capable of producing scores that are easily comparable across texts (Aliyah et al., 2024; Choirul Imam & Laksono, 2018). However, these formulas do not always capture the depth of meaning, inter-sentence relationships, and the pedagogical function of the text. On the other hand, studies in linguistics and learning emphasize that text analysis must consider morphological, syntactic, and multimodal dimensions in instructional material design (Fajriyah et al., 2025; Ferdiawan et al., 2026). Thus, readability measurement requires a more integrative approach.

Furthermore, developments in modern readability research indicate that readability is no longer understood merely as the result of counting word and sentence lengths, but as a

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multidimensional relationship between linguistic structure, cognitive processes, and pedagogical context. (Crossley et al., 2023) assert that classical readability formulas have limitations in explaining *discourse processing* and the reader's experience. (Abdulrahman Almurashi, 2016; Santoso, 2008; Thi Tu Trinh et al., 2017) also demonstrate that NLP-based linguistic features can produce readability evaluations that are more contextual and sensitive to variations in educational texts (Abdulrahman Almurashi, 2016). In this context, linguistic complexity (Freeman, 2013) includes *lexical density, lexical sophistication, syntactic complexity, terminology density,* and *multimodal complexity*, which directly influence students' comprehension.

The main issue in this study is the lack of clarity regarding the mapping of methodological approaches used in readability studies based on linguistic complexity in educational texts. Some studies employ formula-based quantitative methods, others use qualitative analysis of text features and learning contexts, while a few studies combine both through a mixed-methods approach. It is important to examine these differences in approach because each method has different levels of effectiveness, strengths, and limitations in determining the suitability of texts for students.

This study aims to identify the methodological approaches used in readability studies based on linguistic complexity in educational texts and to compare the effectiveness, strengths, and limitations of qualitative and quantitative approaches. The two research questions posed are: (1) what qualitative and quantitative methodological approaches are used in readability studies based on linguistic complexity in educational texts? and (2) how do the effectiveness, strengths, and limitations of qualitative and quantitative approaches compare in evaluating the readability of educational texts?

METHOD

This study employs *a systematic literature review* following the PRISMA 2020 guidelines (Page et al., 2021). Data sources were obtained from the Google Scholar database, focusing on publications addressing readability, linguistic complexity, and educational texts. The selection process consisted of four stages: *identification, screening, eligibility,* and *inclusion*. Inclusion criteria included articles published between 2019 and 2026, written in English, available via open access, in their final published form, and relevant to readability or linguistic complexity analysis in an educational context. Exclusion criteria include articles outside the specified timeframe, non-scholarly document types, non-final publications, unclear journal sources, languages other than English, paywalled articles, and studies irrelevant to the research objectives.

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Of the 500 initial records, 293 articles were eliminated during the automated screening stage. Subsequently, 207 articles were selected based on titles and abstracts, resulting in 41 articles to be assessed for eligibility through full-text reading. In the final stage, 20 articles met the inclusion criteria and were analyzed further. Data were analyzed using narrative synthesis techniques by classifying articles based on methodological approach, text objects, readability indicators, and key findings. The synthesis was then directed toward answering RQ1 and RQ2.

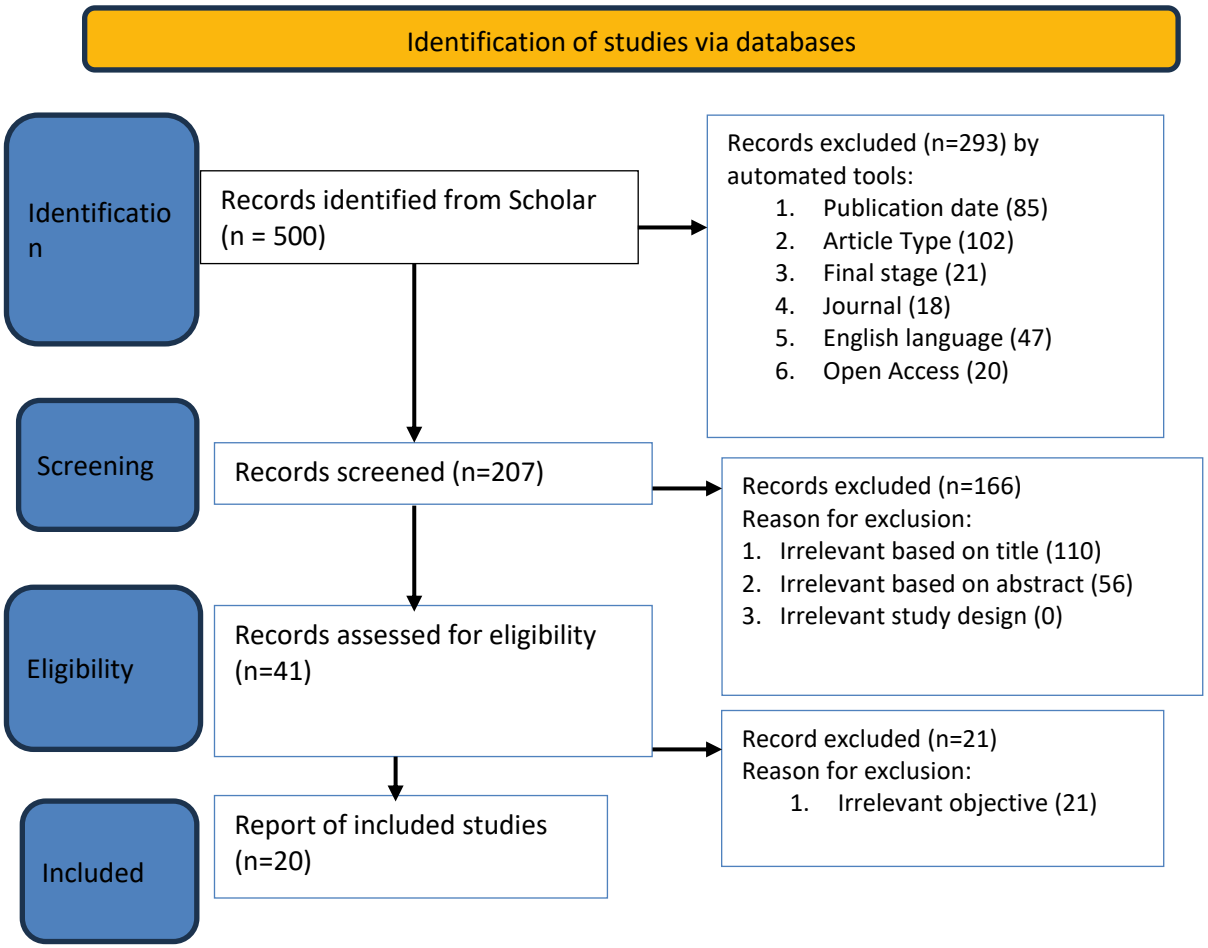


Figure 1 PRISMA Flow Diagram

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Table 1. Inclusion And Exclusion Criteria

Criteria	Inclusion	Exclusion
Year of publication	Articles published between 2019 and 2026.	Articles published before 2019 or outside the specified range.
Document type	Articles from relevant scientific journals or conference proceedings.	Theses, dissertations, popular books, blogs, non-scientific reports, or insufficient metadata.
Language	Articles in English	Articles in languages other than English.
Access	Articles available *in full text* and *open access*.	The articles presented are not available *in full text* or are behind a paywall.
Research focus	Discusses readability, linguistic complexity, and educational text analysis.	Does not discuss text readability or complexity.
Data context	Educational texts, textbooks, modules, e-modules, and teaching materials.	Texts outside the educational context or unrelated to learning.

DISCUSSION

Results of article selection based on PRISMA

The selection process revealed that, out of the initial 500 records, only 20 articles met all inclusion criteria. This significant reduction indicates that while the literature on readability is indeed extensive, studies that specifically link readability, linguistic complexity, and educational texts remain limited. The largest number of exclusions occurred during the automated screening stage, primarily due to mismatched document types and publication years that did not meet the criteria. These findings underscore the importance of source restriction to ensure that the resulting synthesis possesses academic quality and methodological relevance.

During the *screening* stage, 166 articles were eliminated as irrelevant based on their titles and abstracts. This indicates that the keyword “readability” is often used broadly but does not always refer to methodological analyses of educational texts. During the eligibility stage, 21 articles

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were eliminated because their research objectives did not align with the study's focus. Thus, the final 20 articles represent the most relevant studies for addressing the research questions.

Table 2. Summary of the article selection process

PRISMA Stage	Number of articles	Description
Identification	500	Articles identified from Google Scholar.
Automatically excluded	293	Did not meet the criteria for year, document type, publication stage, journal, language, or access.
Screening	207	Articles were selected based on title and abstract.
Excluded during screening	166	Irrelevant based on title or abstract.
Eligibility	41	Articles were assessed through full-text review.
Excluded on eligibility	21	Research objective is not appropriate.
Included	20	Final article for synthesis.

Methodological approaches in studies of the readability of educational texts

The results of the RQ1 synthesis indicate that the quantitative approach is the most dominant method in readability studies based on linguistic complexity in educational texts. The articles reviewed used readability formulas, word and sentence length counts, *lexical density*, *cloze tests*, and computational linguistic indicators. The dominance of quantitative approaches is understandable because readability is often treated as a numerical index that needs to be standardized to determine a text's suitability for a given reader level.

Several studies show a consistent pattern: educational texts often exhibit significant variations in readability levels, even within a single book or instructional material. (Abdulrahman Almurashi, 2016; Angeline De Eloisa Tobing & Sari, 2026; Moon et al., 2025; Rosita & Sulistyani, 2022) indicate that readability scores can be used to identify mismatches between text complexity and reader ability. Findings (Abdulrahman Almurashi, 2016; Dubay, 2004; Freeman, 2013; Noufal

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Azmi Widianto et al., 2024; Thi Tu Trinh et al., 2017) also expand readability measurement through *lexical density*, so that readability is understood not only through sentence length but also through lexical information density.

Qualitative approaches are found in more limited numbers. This approach is used to interpret the suitability of texts in relation to learning objectives, content structure, and learner needs. Studies oriented toward qualitative analysis position readability as a pedagogical issue, not merely a numerical one. Meanwhile, mixed approaches are evident in research on instructional material development, such as *e-booklets* and e-modules. This approach combines readability measurements with expert validation and feasibility testing, thereby better bridging the gap between the objectivity of scores and the learning context.

Table 3. Mapping of articles based on methodological approaches

No	Author	Year	Subject	Approach/Method
1	Ita Rosita & Anjar Sulistyani	2022	Indonesian Language Textbook for Elementary School/Madrasah Ibtidaiyah	Cloze test, qualitative analysis
2	Wahyuni, T. S., Nurjanah, & Nugraha, H. S.	2025	*Sundanese Language Teaching* Guide *for* Junior High School	Document analysis using Fry's Chart
3	Aisyah, Kuswari, & Nugraha, H. S.	2024	Sundanese Language Textbook for Junior High School/MTs	Readability Analysis
4	Aprelianingrum, Muzaki, & Rini	2024	Elementary School/MI Indonesian Language Student Book	SMOG Analysis and AKM Literacy
5	Febriana, Wulandari, & Sari	2022	Indonesian Language Textbook for Grade 7 under the Merdeka Curriculum	Fry Chart
6	Ginanjar, A. A.	2020	Indonesian Language Textbook	Readability Analysis
7	Hakim, Setyaningsih, & Cahyaningrum	2021	Indonesian High School English Textbooks	Readability Level Analysis

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8	Adun Rusyana, Nur Ilmiyati, & Endang Hardi	2026	Higher education zoology text	Systematic Literature Review (PRISMA)
9	Michael K. Rooney et al.	2021	Patient education materials	Readability metrics analysis
10	Ruslan Korniichuk & Mariusz Boryczka	2021	Landing page text	Machine learning & readability indices
11	Mulasih, Suroso, & Anwar Efendi	2025	Javanese-Indonesian bilingual text at the B1 level	Linguistic and readability analysis
12	Rusnadi Efendi	2024	Ecology lab manual	Descriptive readability test
13	Andhani Mayangsari et al.	2021	English-language academic journal article	Quantitative descriptive
14	Dahl, Carlson, Renken, McCarthy, & Reynolds	2021	Middle school readers	Analysis of text complexity & comprehension
15	Ahmed, R.	2023	Biology education texts	Flesch Reading Ease analysis
16	Lee & Kim	2022	Animal anatomy learning materials	Linguistic complexity analysis
17	Putri & Andika	2021	Biology learning materials	Analysis of the relationship between readability and comprehension
18	Rahman, F.	2020	Scientific biology texts	Text complexity analysis
19	Wulandari, S.	2022	Biology learning outcomes	Analysis of the influence of readability
20	Tan & Lim	2023	Science education texts	Cognitive load & multimodal learning

Comparison of the effectiveness of qualitative and quantitative approaches

The results of the RQ2 synthesis indicate that the quantitative approach excels in objectivity and comparability. Readability formulas and linguistic indicators provide scores that can be used to compare texts across books, grade levels, and subjects. This advantage is crucial in the context of standardization, as instructional material developers require initial indicators to ensure

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that texts are neither too difficult nor too easy for students. In this context, quantitative methods are effective as an initial diagnostic tool.

Nevertheless, quantitative approaches have fundamental limitations. Readability scores often do not account for semantic quality, clarity of idea flow, discourse coherence, and the relevance of content to the curriculum. Two texts with the same score may have different levels of difficulty if one contains abstract concepts, disciplinary terminology, or complex discourse structures. Therefore, using readability scores without pedagogical interpretation risks leading to overly mechanical conclusions.

A qualitative approach contributes to aspects that numbers cannot explain. Qualitative analysis can assess how a text constructs meaning, how information is organized, and whether the text aligns with students' prior experiences and knowledge. This strength is crucial for evaluating Indonesian language, mathematics, and science textbooks because each subject has distinct linguistic characteristics. Science texts, for example, often contain technical terms, while mathematics texts require symbolic and procedural understanding. However, the qualitative approach has limitations regarding the consistency of assessment and comparability across studies.

A mixed-methods approach is the strongest alternative because it combines objective measurement with contextual interpretation. In the development of instructional materials, readability scores can be used as baseline data, while expert validation and content analysis are used to ensure pedagogical suitability. Thus, readability standards based on linguistic complexity should not be built solely from formulas, but through a layered evaluation model that combines quantitative indicators and qualitative assessments.

The dominance of quantitative approaches in readability research indicates that the structuralist paradigm remains the primary orientation in the evaluation of educational texts. Formulas such as the Fry Graph, SMOG, and Flesch Reading Ease are chosen because they are practical, objective, and easily replicable across educational levels. However, the synthesis results show that these approaches have not yet been able to fully explain the relationship between language structure, reader experience, and pedagogical objectives. Findings (Rusyana et al., 2026) show that zoology texts with scientific terminology and complex classification structures increase students' extraneous cognitive load. This indicates that text difficulty is influenced not only by sentence length but also by conceptual density and information structure.

The study (Putri et al., 2024) expands the concept of readability through an analysis of lexical density and readability in IELTS texts. The study shows that lexical density affects readers'

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processing capacity. This finding aligns with a study (Mayangsari et al., 2021) that identifies lexical sophistication as a key indicator in measuring academic readability. Thus, modern readability is shifting from mechanical measurement toward an evaluation of linguistic information complexity.

Additionally, multimodal approaches are beginning to emerge in educational readability research. (Setyaningsih, 2023) explains that the integration of linguistic and visual elements can help readers understand abstract concepts through the support of multimodal representations. This approach is particularly important for science and mathematics texts, which possess more complex symbolic and terminological characteristics compared to ordinary narrative texts.

Table 4. Comparison of methodological approaches in readability evaluation

Approach	Effectiveness	Advantages	Limitations
Quantitative	Effective as a tool for initial diagnosis and cross-text comparison.	Objective, efficient, standardized, and easy to replicate.	Fails to capture context, meaning, coherence, and pedagogical appropriateness.
Qualitative	Effective for understanding the function and quality of texts in learning.	In-depth, contextual, sensitive to content and readers.	More subjective, difficult to generalize, and requires expert evaluators.
Mixed	Most effective for comprehensive evaluation of instructional materials.	Combines measurable scores and pedagogical interpretation.	Requires more time, data, and complex analysis procedures.

Implications for educational text readability standards

The findings of this study indicate that the development of educational text readability standards can no longer rely entirely on classical readability formulas. Formulas such as *the Fry Graph*, *Raygor Readability Estimate*, and *Flesch Reading Ease* are indeed still relevant as initial indicators for quickly and objectively measuring text difficulty. However, various studies show that these formulas tend to measure only surface-level linguistic aspects, such as sentence length and

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syllable count, and thus fail to fully account for the complexity of text meaning and structure (Crossley et al., 2023). In the context of modern education, readability is not only related to the linguistic characteristics of a text but also to the reader's abilities and the learning objectives to be achieved. Therefore, readability evaluation requires a more comprehensive approach so that the assessment results are not merely mechanical.

Furthermore, research findings indicate that linguistic complexity significantly influences the comprehensibility of educational texts. Aspects such as lexical *density*, syntactic complexity, inter-sentence cohesion, and the use of technical terms have been shown to affect students' ability to comprehend the content of a text (Noufal Azmi Widianto et al., 2024; Resnick & Halliday, 2014; Saddique et al., 2025; Syarif et al., 2018). Texts with high term density and long sentence structures tend to be more difficult to understand, especially for readers at the elementary and junior high school levels. Conversely, texts with clear information organization and simpler language are easier for students to process. These findings reinforce the view that readability analysis needs to consider linguistic characteristics in greater depth, rather than relying solely on general numerical indices.

This study also underscores the importance of adjusting readability levels according to educational grade levels. Texts deemed appropriate for high school students may not necessarily be optimally understood by elementary or middle school students. Differences in reading ability, vocabulary mastery, and cognitive development mean that each educational level requires distinct text characteristics (Puskurbuk, 2022). The Book Grading Guidelines emphasize that reading materials must be adapted to the reader's developmental stage to effectively support learning and enhance students' reading interest. Thus, the development of readability standards must prioritize educational levels as a key factor in evaluating textbooks.

In addition to considering linguistic aspects and reader levels, readability analysis must also be integrated with a pedagogical perspective. Readability assessment should not stop at assigning scores or classifying text difficulty levels but must provide practical recommendations for instructional material development. The results of readability analysis can be utilized to simplify sentence structure, clarify relationships between ideas, reduce the use of overly technical terms, and adapt the presentation of material to students' needs (Kusumaningtyas et al., 2025; Nurjamilah et al., 2025). Thus, readability serves not only as an evaluation tool but also as a foundation for the revision and development of more effective educational textbooks.

Conceptually, this study positions readability as an interaction between text, reader, and learning context. This perspective indicates that readability standards cannot be applied uniformly

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across all subjects. Indonesian language, mathematics, and science textbooks possess distinct linguistic characteristics, thereby requiring different evaluation approaches. Indonesian language texts predominantly feature narrative and expository structures, while Mathematics tends to use symbols, procedures, and abstract representations. Meanwhile, Science texts extensively utilize technical terms and complex explanatory structures. These differing characteristics necessitate that each subject area require more specific and contextual readability indicators (Fitzgerald et al., 2015).

Based on these findings, the integration of quantitative and qualitative approaches is the most relevant strategy for developing readability standards for educational texts. Quantitative approaches can be used to produce objective and consistent measurements, while qualitative approaches provide a deeper interpretation of the context of language use and readers' needs. The combination of these two approaches enables the development of readability standards that are more accurate, practical, and aligned with current educational needs. With more comprehensive standards, textbook evaluations are expected not only to assess language difficulty levels but also to support the creation of more effective learning that is focused on strengthening students' literacy (Page et al., 2021).

CONCLUSION

Based on the results of *a systematic literature review* of 20 articles, it can be concluded that readability studies based on linguistic complexity in educational texts are dominated by quantitative approaches. This approach is effective for producing objective, standardized, and comparable readability scores. However, quantitative approaches have limitations in explaining the context, meaning, and pedagogical function of the text. Qualitative approaches provide deeper interpretations but have limitations in terms of objectivity and generalizability. Therefore, a mixed-methods approach is the most comprehensive option for evaluating the readability of educational texts.

The implication of this research is the need to develop readability standards that integrate readability formulas, linguistic complexity indicators, and pedagogical analysis. Further research is recommended to develop a readability evaluation model that specifically distinguishes the characteristics of texts at the elementary, junior high, and senior high school levels, as well as in the subjects of Indonesian Language, Mathematics, and Science.

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AI USE DECLARATION

This article has been checked for AI usage at 18%; parts of this manuscript were drafted and edited with the assistance of ChatGPT (OpenAI) to improve structural clarity, academic language consistency, and article formatting. All content, data, interpretations, citations, and conclusions have been reviewed, edited, and validated by the author. The author is fully responsible for the originality, accuracy, and scientific integrity of the final manuscript.

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