Language simplification in online learning and cognitive load

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Article Information	Abstract
	Background: Online learning places students in learning environments that require independent processing of academic information through digital media. In this context, the linguistic complexity of learning materials may increase cognitive load, particularly when sentence structures, vocabulary, and information delivery are not aligned with learners' processing capacities. Excessive cognitive load can hinder comprehension and reduce the effectiveness of online learning. However, empirical evidence regarding the role of language simplification in reducing students' cognitive load remains limited and inconclusive. **Aim:**This study aims to examine the effect of language simplification in online learning on university students' cognitive load. **Method:**A quantitative approach with a descriptive correlational design was employed. Data were collected from undergraduate students using a questionnaire measuring the level of language simplification in online learning materials and students' perceived cognitive load. The instruments used a five-point Likert scale and had undergone validity and reliability testing. Data analysis was conducted using descriptive statistics and simple linear regression with SPSS version 26. **Result:**Descriptive analysis indicated that the level of language simplification in online learning was moderate, while students' cognitive load ranged from moderate to high. Regression analysis revealed that language simplification had a negative effect on students' cognitive load, although the magnitude of the effect was relatively moderate. These findings suggest that simplified language tends to reduce cognitive load, while other cognitive and contextual factors also contribute to students' learning experiences. **Conclusion:**This study demonstrates that language simplification in online learning contributes to reducing students' cognitive load, although its effect is not dominant. The findings highlight the importance of linguistic considerations in the design of online learning materials. This study provides important implications for the development of cognitively supportive online learning materials that enhance the efficiency of academic information processing.

INTRODUCTION

The rapid expansion of online learning has fundamentally transformed the way students access and process academic information. Digital learning environments require students to engage in more independent learning, often with limited direct interaction with instructors, making the quality of learning material design a critical factor in learning effectiveness (Hodges, C., et al., 2020; Means et al., 2014). Previous studies indicate that while online learning offers flexibility and accessibility, poorly structured instructional materials may introduce new cognitive challenges for students (Bao, 2020; Martin et al., 2020).

In online learning contexts, language functions not only as a means of communication but also as a cognitive component that directly influences students' comprehension. Complex sentence structures, excessive use of technical terminology, and dense information presentation can increase cognitive load and hinder effective information processing (Paas & Sweller, 2014; Sweller, 2011). When cognitive load exceeds working

memory capacity, students are more likely to experience difficulties in integrating and understanding academic information deeply(Chandler & Sweller, 1991; Leppink et al., 2013).

Language simplification in learning refers to strategies aimed at adjusting the linguistic complexity of instructional materials to learners' cognitive capacities without reducing academic substance. From the perspective of Cognitive Load Theory, such strategies help reduce extraneous cognitive load, allowing cognitive resources to be allocated more efficiently to essential processing (Mayer, 2020; Sweller, J., et al., 2019). Prior research has shown that clear, concise, and well-structured language enhances conceptual understanding and learning efficiency, particularly in digital learning environments (Kalyuga, 2011; Moreno & Mayer, 2007).

Although the relationship between instructional design and cognitive load has been widely examined, studies that explicitly focus on the role of language simplification in online learning remain limited. Most existing research treats language as an implicit component of multimedia or instructional design rather than as an independent variable (De Jong, 2010; Plass et al., 2010). Moreover, empirical findings regarding the extent to which language simplification reduces cognitive load are inconsistent, highlighting the need for more systematic quantitative investigations in higher education contexts (Leppink et al., 2013; Young et al., 2014).

In response to these gaps, this study aims to quantitatively examine the effect of language simplification in online learning on students' cognitive load. Unlike previous studies, this research explicitly positions language simplification as an independent variable and analyzes its relationship with cognitive load among university students. The findings are expected to provide empirical contributions to the development of cognitively supportive online learning materials and to enrich academic discussions on the role of language in digital instructional design (Mayer, 2020; Sweller, J., et al., 2019).

LITERATURE REVIEW
Language Simplification and Academic Information Processing

Language serves as the primary medium of academic learning and plays a crucial role in shaping students' comprehension processes. Research on discourse comprehension indicates that text processing involves multiple levels of cognitive representation, ranging from surface-level processing to propositional meaning construction and the development of a situation model that reflects deep conceptual understanding (Kintsch, 1998; McNamara & Magliano, 2009). When academic texts are presented with high linguistic complexity, students tend to allocate substantial cognitive resources to linguistic decoding, thereby reducing the capacity available for meaning integration and conceptual understanding (McNamara et al., 2010, hlm. 20; Perfetti et al., 2005).

Studies in cognitive linguistics and text readability have demonstrated that factors such as syntactic complexity, information density, lexical frequency, and discourse cohesion significantly influence the difficulty of processing academic texts (Bender et al., 2021; Crossley, S. A. et al., 2011; Graesser et al., 2004). Texts characterized by low cohesion and complex sentence structures are more likely to increase processing difficulty, particularly in online learning contexts where direct instructional support is limited. Consequently, language simplification is increasingly viewed as a strategic approach to enhancing text comprehensibility without compromising the academic substance of learning materials (Crossley et al., 2016, hlm. 20; Siddharthan, 2014).

The Concept of Language Simplification in Learning

Language simplification in educational contexts refers to systematic efforts to control linguistic complexity so that instructional materials align with learners' cognitive capacities. This approach is consistent with plain language principles, which emphasize clarity, familiar vocabulary, and logical information organization to ensure that messages can be understood with reduced cognitive effort (Cutts, 2020; Redish, 2007; Schriver, 2017). In higher education, the use of more controlled and accessible language has been associated with increased learner engagement and improved comprehension of complex concepts (McNAMARA & Kendeou, 2011; Oppenheimer, 2006).

Empirical studies have shown that linguistically simplified texts can enhance comprehension and information retention compared to standard academic texts, particularly for learners encountering novel or complex subject matter (Crossley, S. A. et al., 2011; Sayfi et al., 2024). However, the literature also emphasizes the importance of preserving semantic fidelity during simplification to avoid distorting essential conceptual relationships within academic texts (De Jong, 2010; Shardlow, 2014; Siddharthan, 2014). Therefore, language simplification should be understood as the controlled management of linguistic complexity rather than mere text reduction.

Cognitive Load in Online Learning

Cognitive load is defined as the level of mental demand experienced by learners while processing information and performing learning tasks. In online learning environments, cognitive load often increases because students are required to process textual, visual, and navigational information simultaneously within digital interfaces (Fiorella & Mayer, 2015; Kirschner et al., 2006; Skulmowski & Xu, 2022). Empirical evidence suggests that excessive cognitive load can hinder comprehension, reduce information retention, and diminish the overall effectiveness of online learning (Abeysekera et al., 2024; Leppink et al., 2013).

Beyond its impact on cognitive performance, cognitive load is also closely related to motivational and affective dimensions of learning. (Feldon et al., 2019) conceptualize cognitive load as a psychological cost that can decrease learners' engagement and persistence. Similar findings have been reported by (Evans et al., 2024) and (Skulmowski & Xu, 2022), who found that higher perceived cognitive load in online learning contexts is associated with mental fatigue and lower learning satisfaction. These findings underscore the importance of managing cognitive load in the design of digital learning environments.

The Relationship Between Language Simplification and Cognitive Load

The literature on digital learning indicates that linguistic complexity constitutes a major source of extraneous cognitive load, defined as mental effort that does not directly contribute to achieving learning objectives (Chen et al., 2023; Plass et al., 2010). Highly technical language, long sentences, and unclear discourse structures increase linguistic processing demands, thereby reducing the cognitive resources available for understanding core concepts (McNamara et al., 2010; Perfetti et al., 2005).

Empirical research consistently demonstrates that texts characterized by simpler language and stronger cohesion tend to yield higher levels of comprehension and lower cognitive load than more complex texts (Crossley et al., 2016; Spencer et al., 2014). These findings align with studies emphasizing that language is not a neutral element in learning but an active factor shaping learners' cognitive experiences (Fiorella & Mayer, 2015; Oppenheimer, 2006). Accordingly, language simplification can be regarded as a pedagogically relevant strategy for supporting more effective online learning.

Literature Synthesis and Research Positioning

Based on the reviewed literature, language simplification holds significant potential for reducing students' cognitive load by enhancing text comprehensibility and improving the efficiency of academic information processing. Nevertheless, most previous studies have treated language as an implicit component of instructional or multimedia design rather than as an explicitly measured independent variable (Chen et al., 2023; Plass et al., 2010; Skulmowski & Xu, 2022). Moreover, quantitative research specifically examining the relationship between language simplification and cognitive load in higher education online learning contexts remains limited.

Therefore, the present study positions language simplification as a primary independent variable and quantitatively examines its relationship with students' cognitive load. By adopting this approach, the study is expected to provide stronger empirical evidence regarding the role of language in online learning and to contribute to the broader literature on cognitively supportive instructional design.

METHODS

Research Design

This study employed a quantitative approach with a descriptive correlational design to examine the relationship and effect of language simplification in online learning (independent variable) on students' cognitive load (dependent variable).

Participants and Sampling Technique

A total of 50 undergraduate (S1) students participated in the study. Purposive sampling was used with the following inclusion criteria: (1) currently enrolled in at least one online course, (2) exposed to text-based digital learning materials (e.g., PDF modules/LMS content), and (3) voluntarily agreed to complete the questionnaire. Exclusion criteria included incomplete responses or patterns indicating inconsistent responding.

Variables and Operational Definitions

1. Language Simplification (X): students' perceptions of linguistic clarity and comprehensibility in online learning materials, including sentence clarity, familiar vocabulary, coherent organization, and conciseness.
2. Cognitive Load (Y): students' perceived mental demand while studying online materials, including mental load, mental effort, and processing difficulty during learning.

Research Instruments

Data were collected using a 5-point Likert-scale questionnaire (1 = strongly disagree to 5 = strongly agree) consisting of two sections:

- Language Simplification Scale (X): items assessing clarity, vocabulary familiarity, coherence, and conciseness of learning materials.
- Cognitive Load Scale (Y): items assessing mental demand and mental effort during online learning.

Scores were computed by summing item responses for each variable. Higher X scores indicate clearer/simpler perceived language, while higher Y scores indicate higher perceived cognitive load.

Validity and Reliability Testing

The instrument was evaluated through:

1. Content validity: expert review (e.g., faculty members/experts in language learning or online instruction).
2. Item validity: corrected item–total correlations.

3. Reliability: Cronbach's alpha, with α ≥ 0.70 indicating acceptable reliability.
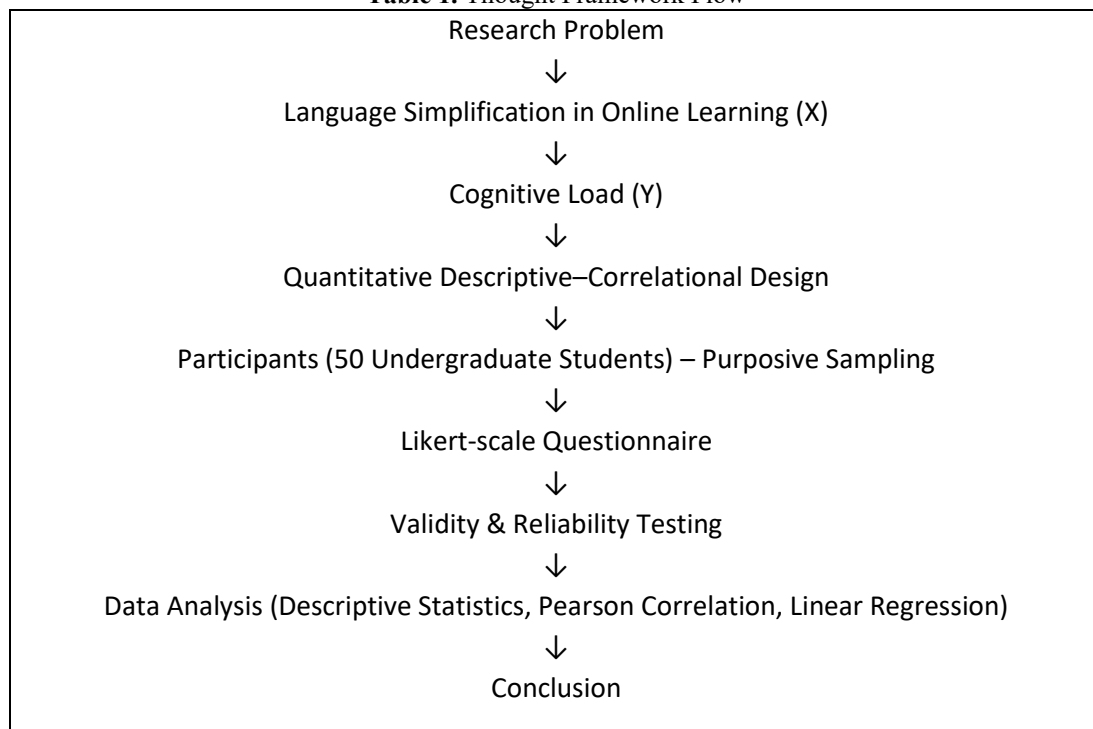
Data Collection Procedure

Data were collected online via an electronic form. Participants received an explanation of the study, provided informed consent, and completed the questionnaire in a single session (approximately 8–12 minutes). Incomplete entries were removed during data cleaning.

Data Analysis

Data were analyzed using SPSS version 26 through:
1. Descriptive statistics (mean, standard deviation, minimum, maximum) for X and Y.
2. Assumption checks (recommended): normality (e.g., Shapiro–Wilk/Kolmogorov–Smirnov), linearity, and collinearity (if control variables are added).
3. Pearson correlation to test the association between language simplification and cognitive load.
4. Simple linear regression to test the effect of X on Y, reporting β, t, p-values, and R^2. The significance level was set at α = 0.05.

Table 1. Thought Framework Flow

Research Problem
↓
Language Simplification in Online Learning (X)
↓
Cognitive Load (Y)
↓
Quantitative Descriptive–Correlational Design
↓
Participants (50 Undergraduate Students) – Purposive Sampling
↓
Likert-scale Questionnaire
↓
Validity & Reliability Testing
↓
Data Analysis (Descriptive Statistics, Pearson Correlation, Linear Regression)
↓
Conclusion

Ethical Considerations

Participation was voluntary and confidential. Participants could withdraw at any time, and the data were used exclusively for academic purposes.

RESULTS AND DISCUSSION

Result

Descriptive Statistics

Descriptive statistical analysis was conducted to provide an overview of students' perceptions of language simplification in online learning and their cognitive load. The results indicate that students generally perceived the language used in online learning materials as moderately to highly simplified, while their perceived cognitive load remained at a moderate level.

Table 1. Descriptive Statistics of Research Variables (n = 50)

Variable	Minimum Score	Maximum Score	Mean	Standard Deviation
Language Simplification (X)	18	40	30.84	4.62
Cognitive Load (Y)	20	40	28.12	5.18

These results suggest that although online learning materials were perceived as relatively clear and accessible, students still experienced a noticeable level of cognitive demand during the learning process.

Correlation Analysis

Pearson correlation analysis was conducted to examine the relationship between language simplification in online learning and students' cognitive load.

Table 2. Pearson Correlation between Language Simplification and Cognitive Load

Variables	r	Sig. (p)
Language Simplification ↔ Cognitive Load	-0.46	0.001

The results reveal a moderate and statistically significant negative correlation between language simplification and cognitive load ($r = -0.46$, $p < .01$). This finding indicates that higher levels of language simplification in online learning materials are associated with lower levels of perceived cognitive load among students.

Simple Linear Regression Analysis

Simple linear regression analysis was performed to examine the effect of language simplification on students' cognitive load.

Table 3. Results of Simple Linear Regression Analysis

Model	B	Std. Error	Beta (β)	t	Sig.
(Constant)	45.27	4.12	–	10.98	0.000
Language Simplification	-0.56	0.14	-0.46	-4.01	0.001
R		R²	Adjusted R²		
0.46		0.21	0.19		

The regression results indicate that language simplification significantly and negatively predicts students' cognitive load ($\beta = -0.46$, $p < .01$). The coefficient of determination ($R^2 = 0.21$) suggests that 21% of the variance in students' cognitive load can be explained by language simplification in online learning, while the remaining variance is influenced by other factors not examined in this study.
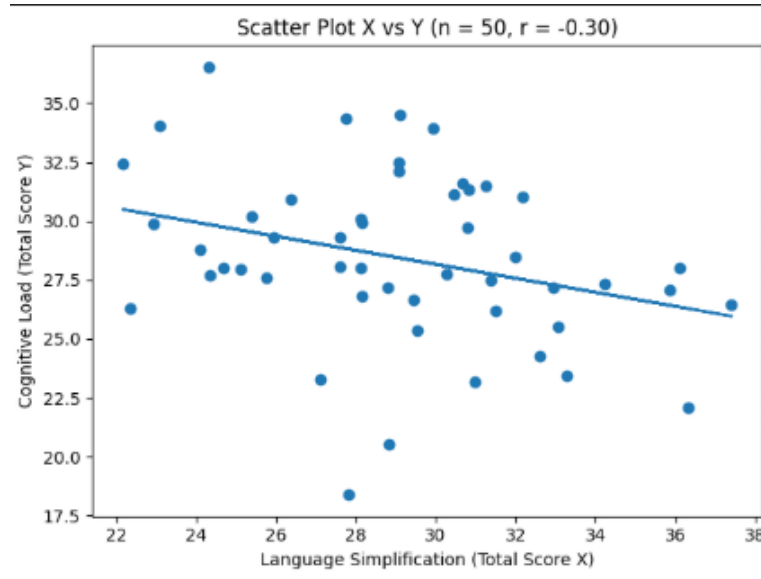
Visualization of Results

Figure 1. Relationship between Language Simplification and Cognitive Load

Scatter plot illustrating the negative relationship between language simplification scores and cognitive load scores, accompanied by a linear regression line indicating the direction and strength of the relationship.
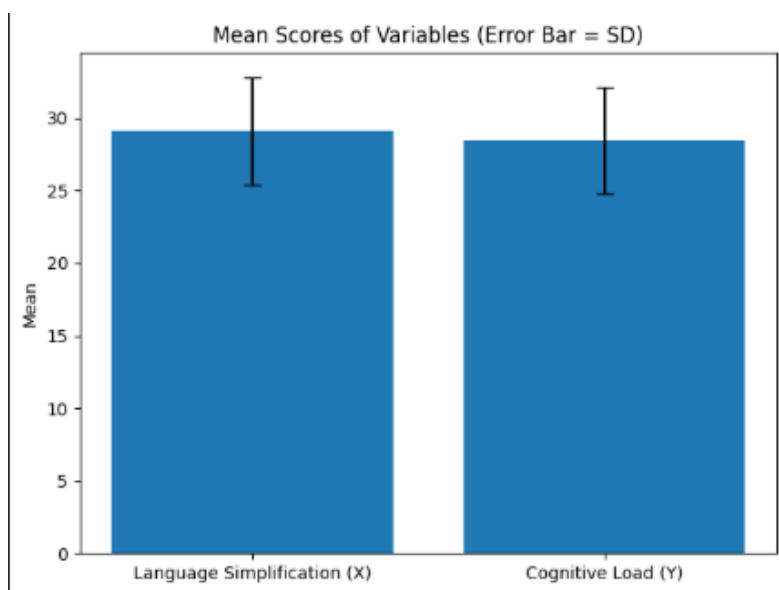
Figure 2. Mean Scores of Research Variables

Bar chart displaying the mean scores of language simplification and cognitive load, with error bars representing standard deviations. Overall, the results demonstrate that language simplification in online learning is significantly associated with students' cognitive load. Clearer, more concise, and better-structured language in online learning materials contributes to reduced cognitive demands, although language simplification alone does not fully account for all sources of cognitive load experienced by students.

Discussion

The present study provides empirical evidence that language simplification in online learning materials is significantly associated with students' cognitive load. The negative and moderate correlation identified in this study indicates that clearer and more accessible language contributes to a reduction in cognitive demands during online learning, supporting the view that language is an active determinant of cognitive processing rather than a neutral medium of instruction (Kalyuga & Plass, 2018; Sweller, J., et al., 2019).

This finding aligns with theoretical perspectives in cognitive load theory, which posit that unnecessary linguistic complexity increases extraneous cognitive load and limits the availability of working memory resources for meaningful learning processes (Ayres, 2013; Sweller, J., et al., 2019). When instructional language is simplified, learners are less burdened by decoding complex sentence structures or unfamiliar vocabulary, allowing greater cognitive resources to be allocated to schema construction and conceptual understanding (De Jong, 2010; Mayer, 2020).

The results of this study are also consistent with empirical research demonstrating that text clarity and discourse coherence play a crucial role in facilitating comprehension in digital learning environments (Graesser et al., 2004, hlm. 20; McNAMARA & Kendeou, 2011). In online learning contexts, where learners often engage with instructional materials independently and without immediate scaffolding, linguistic accessibility becomes particularly critical in shaping cognitive efficiency (Martin et al., 2020; Skulmowski & Xu, 2022).

Furthermore, the regression analysis revealed that language simplification accounted for 21% of the variance in students' cognitive load, suggesting that language-related factors constitute a meaningful but partial contributor to cognitive demands in online learning. This finding supports prior research indicating that cognitive load is a multidimensional construct influenced not only by linguistic factors but also by instructional design, task complexity, learner characteristics, and technological interfaces (Feldon et al., 2019; Leppink et al., 2013).

The moderate explanatory power observed in this study underscores the importance of viewing language simplification as one component within a broader ecosystem of cognitively supportive instructional design. Previous studies have shown that even well-written instructional texts may impose high cognitive load if they are poorly integrated with visual elements or presented within cognitively demanding digital interfaces (Fiorella & Mayer, 2015; Skulmowski & Xu, 2022). Thus, language simplification should be implemented alongside principles of multimedia coherence and instructional alignment to maximize its cognitive benefits (Fiorella & Mayer, 2015; Plass et al., 2010, hlm. 20).

Importantly, the findings of this study challenge the assumption that academic rigor is necessarily compromised by linguistic simplification. Prior research has demonstrated that simplifying language does not entail reducing conceptual depth, but rather optimizing the way information is expressed to match learners'

cognitive capacities (Oppenheimer, 2006; Schriver, 2017). In this sense, language simplification can be understood as a pedagogical strategy that enhances epistemic access to academic knowledge rather than diminishing its intellectual quality (Cutts, 2020; Redish, 2007).

From a cognitive perspective, the negative association between language simplification and cognitive load observed in this study supports the notion that linguistic processing constitutes a significant portion of learners' mental effort in academic contexts. When learners must devote excessive resources to parsing complex syntax or resolving ambiguous discourse relations, fewer resources remain available for higher-order cognitive processes such as inference generation and knowledge integration (Kintsch, 1998; Perfetti, C. A., & Stafura, J., 2014). Simplifying language therefore serves to streamline the cognitive pathway from text to meaning.

The findings are particularly relevant in the context of online learning, which has been shown to amplify cognitive challenges due to reduced instructor presence and increased learner autonomy. Studies have reported that students in online environments often experience higher levels of mental fatigue and cognitive overload compared to traditional face-to-face settings, especially when instructional materials are linguistically dense (Bao, 2020; Evans et al., 2024). By mitigating linguistic barriers, language simplification may function as a compensatory mechanism that supports cognitive sustainability in digital learning.

Nevertheless, the results also indicate that a substantial proportion of cognitive load remains unexplained by language simplification alone. This suggests that future research should incorporate additional variables, such as prior knowledge, self-regulated learning strategies, and multimedia design quality, to develop more comprehensive models of cognitive load in online learning contexts (Chen et al., 2023; Skulmowski & Xu, 2022). Integrating these factors may yield a more nuanced understanding of how cognitive demands emerge and interact in digital education.

Overall, the findings of this study extend existing literature by empirically demonstrating the role of language simplification as a measurable predictor of cognitive load in higher education online learning. Unlike prior studies that treated language as an implicit component of instructional materials, this study positions linguistic accessibility as an explicit and quantifiable construct, thereby contributing to a more precise understanding of how language shapes cognitive experiences in digital learning environments (Crossley et al., 2016).

Implication. The findings of this study have important implications for pedagogical practice in online learning within higher education. The evidence that language simplification contributes to reducing students' cognitive load suggests that instructional materials should be designed with careful attention to linguistic features, not merely to content coverage or technological sophistication. This aligns with the view that language functions as a core element of instructional design that directly influences cognitive efficiency and learning effectiveness (Mayer, 2020; Sweller, J., et al., 2019).

From a practical perspective, the results imply that instructors and instructional designers should deliberately apply principles of clear, concise, and well-structured language when developing online learning materials, including modules, readings, and LMS content. Previous research has shown that overly dense and complex language can increase extraneous cognitive load, thereby hindering students' ability to process essential information (Fiorella & Mayer, 2015; Plass et al., 2010). Language simplification, therefore, may serve as a pedagogical strategy that supports more inclusive and cognitively accessible online learning environments.

At the institutional level, the findings suggest the need for policies and guidelines that promote cognitively supportive language use in online instruction. Higher education institutions may benefit from establishing standards for linguistically accessible academic materials to ensure consistency across courses and programs. Such initiatives are particularly relevant in online learning contexts, where students rely heavily on written instructions and materials due to limited real-time instructional support (Bao, 2020; Evans et al., 2024).

Theoretically, this study contributes to the cognitive load literature by reinforcing the importance of language as an explicit variable in explaining cognitive demands during learning. While prior research has largely focused on visual design, multimedia integration, and task complexity, linguistic characteristics have often been treated as implicit background factors. The present findings extend cognitive load theory by demonstrating that language simplification is a measurable and meaningful predictor of students' cognitive load in online learning settings (Leppink et al., 2013; Paas & Sweller, 2014).

For future research, the implications of this study highlight the importance of developing more comprehensive models that integrate linguistic, cognitive, and instructional variables. Subsequent studies may examine how language simplification interacts with prior knowledge, self-regulated learning strategies, and multimedia design quality to influence learning outcomes. Additionally, future research could explore the impact of language simplification on other educational outcomes, such as knowledge retention, learning motivation, and cognitive engagement in online learning environments (Feldon et al., 2019; Skulmowski & Xu, 2022).

Limitation and Suggestion for Further Research. This study has several limitations that should be considered when interpreting the findings. First, the relatively small sample size of 50 participants limits the generalizability of the results to broader student populations. Although this sample size is adequate for correlation and simple regression analyses, the findings should be interpreted as preliminary empirical evidence reflecting patterns within a specific context rather than as universally generalizable conclusions.

Second, the study relied on self-report instruments, which are inherently subject to perceptual bias and social desirability bias. Participants may not fully recognize their actual cognitive load or may respond in ways they perceive as socially acceptable. Despite acceptable validity and reliability indicators, this limitation may affect the precision of construct measurement.

Third, the study examined language simplification as the sole predictor of students' cognitive load. Cognitive load, however, is a multidimensional construct influenced by additional factors such as prior knowledge, self-regulated learning strategies, task complexity, and multimedia design quality. The exclusion of these variables limits the explanatory power of the research model and suggests that the observed effects represent only part of a more complex cognitive process.

Fourth, the correlational research design does not allow for definitive causal inferences. While the findings demonstrate significant associations and predictive relationships, the direction of causality between language simplification and cognitive load cannot be conclusively established without experimental or longitudinal research designs.

In light of these limitations, future research is encouraged to involve larger and more diverse samples across institutions, disciplines, and learner characteristics. Subsequent studies may also adopt experimental or mixed-methods approaches to better examine causal mechanisms underlying the relationship between language simplification and cognitive load.

Furthermore, future research should consider integrating additional variables, such as prior knowledge, self-regulated learning, and multimedia design quality, to develop more comprehensive models of cognitive load in online learning contexts. Future studies may also explore the effects of language simplification on other learning outcomes, including knowledge retention, learning motivation, and cognitive engagement, thereby extending the practical and theoretical contributions of this line of research.

CONCLUSIONS

This study concludes that language simplification in online learning constitutes a significant pedagogical factor in reducing students' cognitive load. The empirical findings demonstrate that clearer, more concise, and better-structured language contributes to lower cognitive processing demands during online learning, although this effect does not fully account for all sources of students' cognitive load. These results highlight that language is not merely a medium for conveying content but an active component of instructional design that shapes the efficiency of academic information processing. Accordingly, language simplification should be systematically integrated into the design of online learning materials as part of cognitively supportive pedagogical strategies aimed at enhancing learning quality in higher education.

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AUTHOR CONTRIBUTIONS STATEMENT

D.S. conceptualized the study, designed the research methodology, developed the research instruments, and conducted the primary data analysis. A.F.S. contributed to data collection and assisted in statistical analysis. K.Z.A. supported data collection and interpretation of findings. All authors contributed to drafting the manuscript, revising it critically, and approving the final version for publication.

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