Lexical Richness and Syntactic Complexity as Predictors of Academic Writing Performance

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Abstract

Language researchers have long looked for ways to investigate the connection between textual language use and the development of both L1 and L2 writing. The purpose of this research study is to examine the predictors of writing quality in terms of lexical richness and syntactic complexity in academic writing. The study was based on a hypothesis that the lexical sophistication and the mean length T-unit (MLTU) are the indicators of writing quality. A corpus of 50 article abstracts written by Tunisian scholars was analyzed and scored using a holistic scoring rubric that indicates writing quality (test of written English), and then regressed against the chosen measures of lexical richness and syntactic complexity. The findings revealed that lexical sophistication GSL-1 1000 words is the indicator of writing quality. For syntactic complexity, findings showed that the mean length T-unit (MLTU) is not a good predictor of academic writing. However, the clause per T-unit (C/TU) indicated a strong correlation with writing quality. Furthermore, the ability to use sophisticated vocabulary rather than grammatical knowledge was an effective predictor of academic writing. The results of this research can help EFL scholars improve the quality of their writing so they can employ it in academic writing.

Keywords: academic writing, lexical Richness, syntactic complexity, writing quality

Introduction

Second Language (L2) research has covered writing skills and associated factors because academic writing is one of the areas of focus in academia and daily practice. Rosmawati (2019) noted a growth in research on L2 academic writing, particularly in English as a second language. It has flourished and is likely to do so in the future, given the growing trend of international education and the increasing dominance of English as the language of science dissemination. Many studies have called for new methods of measuring and assessing students' performance and the quality of the texts they compose (Bin Hadi et al., 2020). Writing quality refers to the fit of a particular text to its context, including factors such as purpose, discourse medium, and the audience's interest in the subject—factors which are the cornerstones of discourse theory and, mutatis mutandis, should be the cornerstones of research in written composition" (Witte & Faigley, 1981, p.199). Writing quality has been regarded as a key predictor of academic success (McNamara, Crossley & McCarthy, 2010). Documenting the linguistic traits of excellent writing is one way to comprehend factors that predict proficient writing.

Several studies have looked at connections between writing quality and linguistic elements present in texts, particularly elements related to lexical richness and syntactic complexity. For example, Stevenson et al. (2006) studied the relationship between various revision behaviors and text quality. Lower-level revisions (word-level changes) and text content quality were predicted to have a negative relationship in L2 writing because L2 writers are likely to devote more attention to lower-level writing processes, leaving less attention for higher-level cognitive operations, including revisions. This prediction, however, was not met because it was difficult to find a link between revision type and text quality. Miller et al. (2008) also sought to determine if writing behaviours can be used to predict text quality. In addition to revision behaviors, the authors investigated pausing and fluency. Throughout the research, the level of revision (insertions or deletions) was examined. The text's quality was assessed using weighted subscores for content, grammatical and lexical range, accuracy, and fluency. However, the pausing or revision indices could only account for significant variations in text quality. Instead, two fluency measures were identified as strong predictors of text quality: burst and fluency during burst. Another relevant study is Crossley and McNamara (2010) that examined how the number of cohesive devices increased over a semester. According to their study, the number of cohesive devices used in writing indicates text structure and overall essay quality. However, they found that overlapping pronouns and coordinating conjunctions were poor predictors of writing quality. The findings of their study show that the use of cohesive devices in writing is not a reliable predictor of writing quality.

A plethora of L2 and L1 studies suggested that syntactic complexity can be used to assess writing quality, looking into the relationship between syntactic complexity and writing quality. Writing quality is typically indicated by holistic or analytical essay evaluations. Prior research on syntactic complexity has concentrated on the production length, with clausal subordination as a crucial sign of syntactic growth. Despite being a multidimensional construct, syntactic complexity has been typically studied only at the T-unit level, ignoring the complexity at the phrase level (Bulté & Housen, 2014). Crowhurst (1983) reviewed studies on the relationship between the quality and syntactic complexity of written composition as determined by T-unit and clause length. The idea that the two are positively related appears to be supported by several lines of research.

Syntactic Complexity

Second language development research delineates the reliability and validity of syntactic complexity indices in assessing the progress or proficiency of L2 learners. However, according to Lu (2010), this was not feasible due to a shortage of a credible computational tool for calculating syntactic complexity (p.475). Several metrics have been proposed as the

best ways to assess syntactic complexity in L2 writing. The majority of the research points to a variety of L2 complexity measures. In a sample of 40 empirical L2 studies published between 2005 and 2008, Bulté and Housen (2012) identified 40 different complexity measures (cited in Bulté & Housen, 2014, p.44). According to Lu (2011), research in the field focused on one or more measures, such as the length of the production unit, the degree of subordination and coordination, the variety of syntactic structures, and the sophistication of specific syntactic structures (p.36).

Only some syntactic complexity elements have been investigated regarding L2 writing quality. Overall length measures, such as mean length of sentence, mean length of T-unit and mean length of clause, have been used in such studies. Clausal subordination (finite) has also piqued the interest of researchers, who typically measure it in terms of clauses per T-unit. The researcher follows Crowhurst (1983), Lu (2011) and Yang et al. (2015) studies and chooses to use the mean length of T-unit, the mean length of clause, and the clause per T-unit to examine the link between writing quality and syntactic complexity. The reason for selecting these three measures is that most studies in the literature show that they are positively correlated with writing quality.

Lexical Richness

Another measure of L2 proficiency and writing quality is lexical richness. Nation (2002) argues that it is essential for L2 students committed to developing effective written control over academic vocabulary. Laufer and Sim (1985) advocate the same viewpoint, claiming that vocabulary knowledge is the best predictor of whether a text is understood (as cited in Webb & Nation, 2008, p.1). Lexical richness refers to the sophistication and scope of the students' acquired productive vocabulary. It has been acknowledged as a crucial element in L2 education due to its close connection to the learner's capacity for effective oral and written communication (Lu, 2012; p.190). The majority of the literature provides various lexical richness measures. Lexical richness measurements attempt to quantify a writer's usage of a diversified and vast vocabulary. Researchers have been drawn to such metrics based on some grounds: they are used to separate elements that determine the quality of a piece of writing and can be used to examine the connection between vocabulary and word choice (Laufer & Nation, 1995, p. 308).

Some multiple metrics have been used depending on the specified context; no single measure can account for all facets of vocabulary knowledge. In academic writing, lexical indicators frequently involve correctly using words from the instructional content domain (Olinghouse & Leaird, 2009). The Type Token Ratio (TTR), a counter of word frequency in a text, is commonly used to assess lexical richness. It comprises the total word count (tokens) and the ratio of all other words (types).

According to Laufer and Nation (1995), the best lexical richness metrics are lexical originality, density, sophistication and variation. The lexical originality index evaluates students' performance compared to their peers'. The lexical originality of a specific composition is unpredictable because it is defined by both the group factor and the composition itself (Laufer & Nation, 1995). Lexical density is the ratio of lexical terms to total words in a text (Ure, 1971, as cited in Lu, 2012, p.191). However, significant correlation coefficients between this ratio and the holistic assessment of L2 writing is not evident (Linnarud, 1986, Engber, 1995, as cited in Lu, 2012). Lexical sophistication is "the proportion of relatively unusual or advanced words in the learner's text" (Read, 2000, p.203).

According to Lu (2012), there is a significant amount of variation in the definitions of sophisticated words according to the various measures proposed to quantify lexical sophistication" (p. 192). Lexical variation describes the words and expressions that describe the same things or ideas. The number of distinct words is a lexical variation indicator that is simple to understand and has shown promise as a possible indicator of a child's language development. However, since the length of the text affects this measurement, some

standardizations may be preferable when contrasting samples with different lengths (Lu, 2012, p.193).

Problem Statement

Several existing studies acted as a catalyst for this research. For example, Karami and Salahshoor (2014) examined the reader's predictors of their academic reading performance and deduced that "lexical richness is a much stronger indicator than syntactic complexity" (p.24) suggesting examining the predictors in other academic skills. A substantial amount of research verifies that lexical richness metrics are useful quality indicators in English. Vocabulary variables like measurements of lexical diversity, sophistication and density have the potential to be extremely useful in describing essential features of lexical richness and writing quality. However, neither of these studies examined the measures of syntactic complexity and lexical richness, which best indicate the quality of academic writing. Hence, the current study determines whether lexical richness or syntactic complexity is a potent predictor of academic writing performance.

Research questions and Hypotheses:

The overarching questions that frame the investigation are the following:
1. To what extent does lexical richness predict academic writing performance?
2. To what extent does syntactic complexity predict academic writing performance?
3.   Which of these two variables potently predict academic writing performance?

It has been assumed that lexical sophistication indicates a higher academic writing quality in terms of lexical richness. Also, the mean length of the clause (MLC), mean length T-unit (MLTU) and the clause per T-unit (C/TU) were assumed to be potent indicators of writing quality in terms of syntactic complexity. Likewise, lexical richness was assumed to be the most important competence for academic needs.

Method

The inquiry aims to glean quantitative research insights into which lexical richness and syntactic complexity measures are more potent indicators of academic writing quality in the abstract section of research articles. The focus is on the predictive power of the different metrics, highlighting the indicators of academic writing quality.

Tools of Data collection

The data employed in this research consist of 50 article abstracts written by Tunisian research scholars and downloaded from a Tunisian journal dedicated to young researchers (TAYR). The materials were saved in plain text to be uploaded to the computational tool. This study employs three text analysis tools, L2SCA, RANGE, and Coh-Metrix to assess the abstracts.

Test of Written English (TWE)

Holistic scoring is a method of evaluating the overall quality of written performance. The fundamental goal of holistic scoring is to grade tests based on predetermined criteria. According to Reid (1993), holistic scoring does not identify writing difficulties but evaluates the quality of the written product. TWE, a section of the TOEFL test, is considered the best example of holistic scoring. The TWE comprises six scales, each of which is divided into four or five subscales. The 0-5 rating scale identifies dimensions and characteristics of syntactic and rhetorical skills. The Educational Testing Service (2004) claims that the TWE is a criterion-referenced scale and holistically graded to give information about a candidate's capacity to produce and arrange ideas on paper, to back up those ideas with proof or examples, and to apply standard written English norms (p.5). The TWE test allows students to demonstrate

their ability to write about a certain topic. The test gives students 30 minutes to complete their essays, which will be graded holistically. The candidate's ability to organize his response effectively, to sight instances to defend or clarify his/her position and to compose an effective conclusion will determine his/her score.

Syntactic Complexity Analyzer

To make it easier to compute the corpus, the researcher employed a computational tool that automates syntactic complexity analysis - The L2 Syntactic Complexity Analyzer (L2SCA) created by Lu (2010) at Pennsylvania State University. According to Youssef (2019), this software analyses the data using Stanford Parser and Treegex, yielding results for 14 syntactic indicators, such as the length and density of different syntactic structures and the level of coordination and subordination. The researcher chose to use the L2SCA for it is free, simple and capable of analyzing texts in batches. The system has a comprehensive set of syntactic complexity measurements and is highly reliable.

Coh-Metrix

This instrument is a text-processing software proposed by Graesser et al. (2004). This web programme allows researchers to obtain information about cohesion, language and readability. McNamara et al. (2006) state that Coh-Metrix "analyses texts on three major categories of cohesion: coreference, conceptual (LSA), and connectivity (including causal cohesion)" (p.573). Furthermore, they claim that this tool adds computational markers of text cohesion to traditional readability formulas (McNamara et al., 2006; p.573). The computational markers included in the Coh-Metrix are over 200 metrics of cohesion, language, and readability and markers used in computational linguistics. The researcher opts for using the Coh-Metrix for the following reasons. First, several studies have used this software to measure lexical diversity and density. It enables researchers to get much information about their corpus with minimal effort. Second, the program is available, free and easy to use. Graesser et al. (2004) state that "Coh-Metrix is very easy to use. After accessing the Web site and reading the description of the tool, the facility is ready for the user to enter the text." (p.194). The tool is open to the public and represents an opportunity to facilitate the task for researchers to get rigorous information about texts. It was used in this study to obtain information about lexical diversity and density in the article abstracts.

RANGE

This software developed by Nation (2002) determines the frequency of each word type or family in the provided text and the range of each family across texts. It is mainly used to examine the vocabulary richness in a given corpus. According to Webb and Nation (2008; p.1), This program enables the user to decide the vocabulary knowledge required to understand the text, to generate word lists based on the frequency of usage and variety of use in various kinds of discourse, to figure out the number of occurrences with words in the text, and finally to assess the vocabulary load of a text for learning and to teach a language. The Academic Word List and the 14 British National Corpus (BNC) 1000-word lists were also heavily reliant on this software. The corpus is compared to the GSL-1 1000 most frequent words in English and the GSL-2 1000 most frequent words in this study.

Data Analysis

The data analysis involved two phases. The first phase assessed the research abstracts using a holistic scoring rubric. Two researchers participated in the evaluation of the abstracts The second phase involves quantitatively analyzing the various syntactic complexity and lexical richness statistics. To explore and describe the phenomenon under scrutiny, descriptive statistics were computed using SPSS. Pearson correlation analysis was also used to

determine how lexical richness and syntactic complexity relate to writing quality. Multiple regression analyses were performed to determine how these elements influence writing quality. According to the standards, the corpus was evaluated on a scale from 0 to 5. Then, the researcher independently evaluated 10 randomly selected abstracts to check the degree of reliability. A correlation was calculated to test the agreement among the raters, yielding an inter-rater reliability index (r =.745).

Results

This section outlines the findings in correspondence to the research questions that directly related to the predictors of academic writing quality regarding lexical richness and syntactic complexity. After computing the syntactic complexity and lexical richness measures, correlation and standard multiple regression analyses were applied to statistically evaluate the data. A multiple regression analysis was performed by picking elements with shared relationships to determine the predictors of writing quality.

Research Question1:

Regarding the first research question, it is critical to demonstrate causality between several independent variables and one predictor variables results. Multiple regression analysis was employed to discover the precise lexical richness measure that predicts overall writing proficiency. In this study, lexical richness was measured by using lexical sophistication, density and diversity. Table 1 shows a significant regression equation is ($F_{(4, 45)} = 6.142$, $p = .000$), with an R^2 of .353. In other words, using diversity, density, and sophistication can illustrate 35.3% of the variance in writing quality, which is statistically significant. The F value is 6.142, the effective regression degree of freedom is 4, the effective residual degree of freedom is 45, and the corresponding p-value is 0.000. Thus, the significant level at the 95% confidence interval level is 0.000, which is less than 0.05, indicating that the regression model is significant ($p=.000 < 05$). Furthermore, Durbin Watson's d is 1.924, implying a positive autocorrelation because the value is less than 2 points.

Table 1. *Lexical Richness measures as Criterion Variable*

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | | Durbin-Watson |
					R Square Change	F Change	df1	df2	Sig. F change	
1	,594ᵃ	,353	,296	,53618	,353	6,142	4	45	,000	1,924

The unstandardized coefficients in Table 2 show that one lexical richness measure positively correlate to writing quality. The coefficient column shows that lexical sophistication GSL-1 1000 words (B=.006) is the measure that strongly correlates with writing quality. Furthermore, the standardized regression coefficients emphasize the results showing that lexical sophistication (.010 < .05) appears to be more strongly connected to writing quality than lexical diversity and density. In addition, although lexical sophistication is statistically significant, the table indicates that lexical diversity and density are not statistically significant. Regarding the collinearity statistics, the table shows that all the VIF values are less than 10.

As a result, there is no multicollinearity. Consequently, there are no difficulties in finding a relationship between the lexical richness predictors and the dependent variable. The standardized coefficient beta value in Table 2 is highly suggested. The final model is as follows: Writing quality = 2.870 + (,007*density) + (.006 *sophistication – GSL 1) + (.037*sophistication – GSL 2) + (,002*diversity).

Table 2. *Lexical Richness Predictive measures of Writing Quality*

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
Writing quality	2,870	1,245		2,305	,026		
Lexical density	,007	,022	,044	,305	,762	,682	1,466
Lexical sophistication-GSL1	,006	,002	,401	2,690	,010	,646	1,547
Lexical sophistication-GSL2	,037	,020	,282	1,790	,080	,579	1,727
Lexical diversity	,002	,004	,067	,510	,613	,833	1,201

Research Question2:

In order to answer the second question, the same procedures were used to determine the syntactic complexity predictor of writing quality. Table 3 shows that a non-significant linear regression was discovered (F (3.46) =2, 108, p=, 112), with an R2 of.064. In other words, using syntactic complexity measures can describe 6.4% of the variance in writing quality. The F value is 2,108, the effective regression degree of freedom is 3, the effective residual degree of freedom is 46, and the p-value is at the.112 level. Thus, the significance value at the 95% confidence interval level is 0.112, which is greater than 0.05, indicating that the regression model is not significant (p =.112 >.05). Furthermore, Durbin Watson's d is 1.954, implying a positive autocorrelation because the value is less than 2 points.

Table 3. *Syntactic Complexity measures as Criterion Variable*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	,348[a]	,121	,064	,61824	,121	2,108	3	46	,112	1,954

A regression model was used to quantify the function that each syntactic complexity measure plays in academic writing quality. The regression procedure shows that Clause per T-unit (C/TU) could determine academic writing quality since the significance is .027, which is less than 0.05 (p = .027 < .05). The unstandardized coefficients in table 4 indicate that two of the metrics are not positively correlated with writing quality (mean length of T-unit and mean length of clause). The standardized regression coefficients show that Clause per T-unit (C/TU) appears to be more strongly correlated to writing quality than MLTU and MLC. In addition, the table indicates that the two measures are not statistically significant. Regarding collinearity statistics, the table indicates that all the VIF values are less than 10. Therefore, there is no multicollinearity, and there are no difficulties finding a relationship between the syntactic complexity measures and the dependent variable. Table 4 suggests that the standardized coefficient beta value be included. The final model is as follows: Writing quality = 4,851 + (-, 009*MLC) + (-, 034 *MLTU) + (, 642*C/TU).

Table 4. *Syntactic Complexity Predictive measures of Writing Quality*

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	4,851	,478		10,153	,000		
	MLC	-,009	,030	-,047	-,304	,762	,790	1,266
	MLTU	-,034	,022	-,259	-1,535	,132	,672	1,487
	C/TU	,642	,280	,348	2,289	,027	,825	1,211

Research Question3:

In relation to the third question, the regression analysis revealed that lexical richness (through lexical sophistication GSL-1 1000 words) is the potent predictor of academic writing. The following table shows that lexical sophistication GSL-1 1000 words strongly correlates with writing quality (B=.007) and it is statistically significant (,000 < 0.05). The predictive model is - Writing quality= 3,446+ (, 195*C/TU) + (, 007* Lexical sophistication GSL-1000)

Table 5. *The Predictive measure of Writing Quality*

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	3,446	,242		14,260	,000		
	C/TU	,195	,234	,106	,833	,409	,936	1,068
	Lexical sophistication GSL-1000	,007	,002	,501	3,940	,000	,936	1,068

Discussion

Examining the lexical richness and syntactic complexity metrics in 50 article abstracts written by Tunisian scholars determined the best predictor of academic writing quality. The analysis focused on three major questions. Regarding the lexical richness measures, multiple regression analysis shows that the results met the hypothesis that lexical sophistication is the best predictor of vocabulary load in academic writing. The findings indicate that Tunisian research scholars tend to use the first 1000 most frequent words (GSL-1) in their abstracts. They reflect sophistication in their performances because it indicates a higher quality of academic writing. In this vein, Crossley (2020) states that more sophisticated words depict higher-quality texts, and writers evolve over time to generate more sophisticated vocabulary items.

These findings are in accordance with Crossley (20200, Read (2000) and Ha (2019), suggesting that lexical sophistication is one of the richest metrics of text quality. According to Crossley (2020), more complex words in written outputs imply higher vocabulary knowledge and writing skills. The findings in Ha's (2019) study concluded that lexical sophistication was the best indicator of EFL learners' writing performance among the metrics that demonstrated lexical richness. Similar to the results found in Gregori-Signes & Clavel-Arroitia (2015), she argues that sophistication is a valid and reliable indicator of lexical richness in writing (Ha, 2019, p.21) Moreover, the results also indicate that lexical density is the least predictor of writing quality. The findings in Engber's (1995) study validate the results of this study.

Evaluating the four measures of lexical richness, she claims that lexical density has little if any, relation to the quality of academic writing (Engber, 1995, p.148)

However, other studies conducted on automated lexical metrics exhibited contrastive results. Crossley, Salsbury and McNamara (2011) examined different lexical richness indices and concluded that imageability of the word property index is the best indicator of writing quality (p.255). Olinghouse and Wilson (2013) argue that the predictive metrics of vocabulary knowledge differ depending on the genre. They state that "the vocabulary constructs related to writing quality differed by genre. For story text, vocabulary diversity was a unique predictor, while for persuasive text, content words and register were unique predictors." (Olinghouse & Wilson, 2013, p.45). Additionally, these authors conclude that lexical diversity was the main lexical factor affecting writing quality (Olinghouse & Wilson, 2013, p.45).

Regarding syntactic complexity, the results prove that the clause per T-unit (C/TU) indicates general writing quality. The results contradict Nolan's (2021) study that concluded that lexical and syntactic complexity can both be effective predictors of writing quality, with lexical complexity measures showing more predictive power than syntactic measures (Nolan, 2021, p.11). Similarly, Homburg's (1984) study showed significant positive correlations between writing proficiency and metrics like mean length T-unit (MLTU). This supports the view that indicators of syntactic complexity, such as clause mean lengths, predict writing quality and performance (Biber et al., 2016). This study's results are also inconsistent with Taguchi et al. (2013), who revealed that noun phrase modification enhanced essay quality.

To summarize, the overall objective of this research was to determine the role of syntactic measures in academic writing as compared to lexical richness. Previous research theories and findings hypothesized that syntactic complexity could be a powerful indicator of academic writing as lexical richness. However, this study proved the opposite. The results showed that lexical richness, through lexical sophistication GSL-1 1000 words, is the potent predictor of academic writing. The results indicated that lexical sophistication is a far better indicator of academic writing than the Clause per T-unit (C/TU). Furthermore, it can be argued that syntactic complexity is no longer the sole source of challenges in academic writing.

Conclusion

Prior studies have shown distinct and coherent correlations between linguistic characteristics and writing quality. Higher-rated essays have more complex vocabulary items, more complex grammatical features, and greater cohesion. Students also exhibit trends toward using more complex syntactic structures and sophisticated vocabulary. This study showed significant correlations between the lexical sophistication of GSL-1 1000 words and the clause per T-unit (C/TU) and writing quality. However, this research proved that lexical sophistication is a powerful indicator of writing quality. The pedagogical opportunity represented by these results regarding lexical development is worth noting. The results are significant from a pedagogical standpoint, indicating the importance of considering lexical quality when developing writing lesson plans. It is crucial to analyze the lexical richness traits found in students' writing because doing this can assist teachers in identifying the vocabulary abilities and flaws of their students. Some limitations bound the study's capacity to be generalized. The sample size was relatively small, and the sampling strategy was not random. Another limitation is focusing on syntactic complexity measures without investigating lexical complexity measures. A third research limitation can be seen in the corpus analyzed. The study focused on abstracts written by linguistics scholars without analyzing abstracts from other disciplines. Future studies could be conducted to examine writing quality predictors in other research disciplines and genres or examine the effects of syntactic complexity and lexical richness measures on other academic skills. L2 researchers could examine non-length metrics of syntactic complexity in academic writing.

Disclosure Statement:

I (the author of this paper) hereby declare that research ethics and citation principles were taken into account at all stages of the writing process. In the event of a conflict, I accept full responsibility for the paper's content.

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