

# The role of syntactic and lexical complexity in undergraduate writing quality

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## Abstract

This study explores the L2 production of university students enrolled in an English as a Medium of Instruction (EMI) course, by means of the analysis of the complexity of their academic writing performance. It focuses on syntactic and lexical complexity and their relationship with L2 writing quality and L2 proficiency. The participants were 182 L2 college-level students at different levels of proficiency in English. The essays were evaluated by means of both global ratings of writing quality and quantitative measures of syntactic and lexical analysis. Results showed that the length of sentences and noun phrases, as well as subordination are all related to writing quality. In addition, the length of noun phrases along with lexical richness and diversity can differentiate proficiency levels. This study shows a greater use of complex phrasal constructions in the writing of more competent college-level students. Finally, our study has proved that at advanced competence levels syntactic and lexical complexity are not synchronous, as syntactic complexity remains stable while lexical complexity continues increasing.

**Keywords:** L2 academic writing, writing quality, L2 proficiency, complexity, EMI.

## Resumen

### *La complejidad sintáctica y léxica en la calidad de la escritura académica*

El presente artículo estudia la producción escrita de los estudiantes universitarios de un curso en el que el inglés es la lengua de instrucción (*EMI: English as a Medium of Instruction*) por medio del análisis de la complejidad de sus escritos.

Esta investigación se centra en la complejidad sintáctica y léxica y su relación con la calidad de la escritura y con el nivel de competencia lingüística en la L2. Los participantes son 182 estudiantes universitarios con distintas competencias lingüísticas en inglés. Las redacciones se han analizado según su calidad global y por medio de medidas cuantitativas de la complejidad sintáctica y léxica. Los resultados obtenidos han mostrado que la longitud de las oraciones y de los sintagmas, así como la subordinación, están relacionados con la calidad de la escritura. Además, la longitud de los sintagmas y la riqueza y diversidad léxicas distinguen diferentes niveles de competencia. Se observa un mayor uso de sintagmas complejos en los escritos de los estudiantes con mayor competencia. Por último, en los niveles avanzados de competencia, la complejidad léxica y sintáctica no se desarrollan al mismo tiempo, ya que la complejidad sintáctica permanece estable mientras la léxica continúa aumentando.

**Palabras clave:** Escritura académica en L2, calidad de la escritura, competencia en L2, complejidad, EMI.

## 1. Introduction

English-medium instruction (henceforth EMI), the English instruction method covered in this study, has become a common practice in higher education institutions all over the world (e.g., Galloway & Ruegg, 2022; Qiu & Fang, 2022). A recent line of research in EMI has focused on the analysis of reasons why students enrol in EMI programmes (e.g., Iwaniec & Wang, 2022; Jiang & Zhang, 2019). These studies have shown that EMI learners are more motivated to use languages and to learn than their peers in non-EMI contexts, which has led to the conclusion that learners enrol in EMI essentially to improve their command of the English language (Iwaniec & Wang, 2022; Madrid, 2021).

However, there is a dearth of studies exploring the linguistic aspects that are significant for students in EMI programmes and which need pedagogical attention. Specifically, there is currently little research into L2 writing in EMI contexts. Thus, while studies into the relationships between complexity and L2 writing do exist, no studies to the best of our knowledge have been devoted to this relationship in the context of EMI courses and even more so incorporating both syntactic and lexical complexity in the analysis.

Writing in a second or foreign language has become over the past three decades a well-established field of study, involving well-defined areas of interest and specific methods of research. In addition, the exploration of the

assessment of L2 writing abilities and the pedagogical implications of such studies have become relevant research topics in English language teaching and in the field of applied linguistics in general.

Regarding the study of L2 writing, it seems clear that describing the development of writing abilities is nevertheless difficult due to the complexity of this skill as L2 writing is a complex activity that can be conceptualized from multiple perspectives. In our approach to the study of L2 writing, we follow Larsen-Freeman (2006), who regards language development “as a complex dynamic process that cannot be totally accounted for by performance in any one subsystem or dimension” (2006, p. 592). One of the main premises of the Complex Dynamic Systems Theory (CDST) approach Larsen Freeman adheres to is that different subcomponents of language develop as the learner becomes more proficient or advanced. A perspective from CDST acknowledges both success and failure before actual mastery, resulting in non-linear progression.

Written competence as a subset of language competence is also complex and can only be explained by the interaction of different dimensions of language proficiency. The notions of complexity, accuracy and fluency have been proposed as the principal constructs to study the multidimensional nature of L2 writing performance (Skehan, 1998; Ortega, 2012). Research has shown that these three dimensions of language proficiency are reliable indexes of a learner’s written competence and have therefore become significant factors in the description of L2 writers’ achievement (Ellis & Barkhuizen, 2005).

The present study focuses specifically on two subcomponents of complexity, syntactic and lexical complexity. Syntactic complexity can be defined as “the range and the sophistication of structural and grammatical resources exhibited in language production” (Ortega, 2015, p. 82). Lexical complexity means “that a wide variety of both basic and sophisticated words are available and can be accessed quickly” (Wolfe-Quintero et al., 1998, p. 70).

For present purposes and following Bulté and Housen (2014, p. 46), we propose to define complexity as “an absolute, objective, and essentially quantitative property of language units, features, and (sub)systems”. In short, a system is more complex if it consists of many components and there are dense relationships between these components.

Regarding L2 proficiency, it refers to the general competence to use the L2. A learner’s L2 proficiency may be inferred from or assessed by means of placement tests or others based on the Common European Framework of

Reference for Languages (CEFR) or through assessments of concrete instances of L2 use and production. In regard to quality, this can be evaluated by means of analytic scales, which show global rating of writing quality. These scales may include different features (vocabulary, grammar, organisation, etc). Finally, the changes in the L2 proficiency of a learner over time is what could be defined as L2 development. In a cross-sectional study, like the one presented in this paper, the degree of variation may be assessed using objective complexity measures (e.g., average length of different linguistic units or a ratio of a specific subtype of a linguistic unit) to analyse variation in lower and in higher levels of proficiency.

The present study, which addresses complexity development among EMI students, is both theoretically and pedagogically meaningful as research has shown that bilingual programmes involving dissimilar languages such as Spanish and English require a heightened focus on language that may be beyond the knowledge and skills of content teachers (Macaro et al., 2019). These teachers usually have a limited understanding of language learning and require specific focus on language awareness as student grades are sometimes negatively affected when compared with those taught in their mother tongue (Macaro et al., 2019).

This study intends to fill in that research gap focusing on writing. In this respect, the strength of the current study is to investigate both syntactic and lexical complexity through multiple measures to understand L2 learners' writing development in an EMI context.

## **2. Review of the literature**

The present review of the literature is organized thematically as it addresses three groups of studies: studies that investigate the relationship between complexity and writing quality, studies dealing with the relationship between complexity and L2 proficiency, and studies that focus on the relationship between syntactic complexity and lexical complexity. These studies are presented chronologically.

### **2.1. Complexity and writing quality**

A significant relationship between subordination and writing quality is observed in early studies carried out with ESL students such as Flahive and

Snow (1980) and Homburg (1984), the latter finding a significant relationship between complexity and the length of sentences and clauses as well. On the other hand, two other early studies with adult EFL learners did not find significant differences in complexity scores as measured by subordination (Bardovi-Harlig & Bofman, 1989), and as measured by mean length of T-unit and mean length of sentence (Larsen-Freeman & Strom, 1977).

Some more recent studies have also addressed the extent to which syntactic and/or lexical complexity are indexes of L2 writing quality. In studies with L2 college level writers, Taguchi et al. (2013) reported that phrasal complexity was a significant indicator of written quality. This finding tallies with a later study also undertaken in a college context: Casal and Lee (2019) explored the relationship between syntactic complexity and the writing quality of research papers written by ESL undergraduate writers using both holistic and detailed measures of complexity. Results showed that high-rated essays had the highest number of complex nominals and included significantly more of three types, namely, attributive adjectives as pre-modifiers, prepositional phrases as post-modifiers, and participial clauses as modifiers than low-rated essays.

In a study with adult ESL learners, Bulté and Housen (2014) found positive correlations between analytic scale ratings of learners' overall writing quality and lexical richness (which indicates variation in as well as number of word types used), but not lexical diversity (which provides an indication of the degree of words' repetition in a text) or lexical sophistication (which indicates the extent to which a learner uses "advanced" words). In a similar study also with adult foreign language learners, Yang, Lu and Weigle (2015) found that mean length of sentence and mean length of T-unit were able to predict writing quality. They also reported significant positive correlations for lexical diversity and writing quality.

## 2.2. Complexity and L2 proficiency

There is also empirical evidence in the literature of a link between the syntactic complexity in L2 production and L2 proficiency. Lu (2011) reported that as the L2 proficiency of a group of college students increased, they wrote longer sentences and noun phrases. Ai and Lu (2013) found an increase in complexity at diverse levels of syntactic organisation: At the sentential (length of sentential units), clausal (coordination and

subordination) and phrasal level (length of noun phrases) while Mazgutova and Kormos (2015) reported an increase at the clausal (coordination and subordination) and phrasal level (length of noun phrases) as L2 proficiency increased.

Findings by Kim (2014) showed that more proficient college-level English learners wrote longer sentences and noun phrases and used more diverse vocabulary than less proficient learners did. In the same vein, Yoon (2017) found that the college-level EFL students with the highest levels of proficiency used complex noun phrases significantly more than the students with the lowest level of proficiency.

In two studies that addressed complexity at different study levels, Staples et al. (2016) demonstrated that graduate students used significantly more nominalizations, attributive adjectives, and premodifying nouns than first-year, second-year, and third-year undergraduate students while Ansarifar et al. (2018) found that MA students used four types of noun modifiers (i.e., attributive adjectives, pre-modifying nouns, *-ed* clauses, and multiple prepositional phrases) significantly less than expert writers; however, this was not the case for the PhD students except for multiple prepositional phrases as noun post-modifiers (2018, p. 69).

Recent studies like Lan et al. (2019) investigated a corpus of argumentative papers written by university students at high, intermediate and low proficiency levels of English competence. This study demonstrated that the use of noun modifiers was influenced by the students' L2 competence with four noun modifiers contributing the most to this association, namely, attributive adjectives, premodifying nouns, relative clauses, and prepositional phrases (of) (2019, p. 8). Jiang et al. (2019) found that intermediate EFL learners tend to produce longer sentences, T-units and clauses, more subordinate clauses, more coordinate clauses, and more noun phrases in their writings than beginner students. For their part, Barrot and Agdeppa (2021) found a significant relationship between L2 proficiency and the length of production unit indexes (mean length of sentence, T-unit and clause) as well as the degree of phrasal sophistication indexes (complex nominal per clause and complex nominal per T-unit). Finally, findings by Khushik and Huhta (2022) showed that the most important indexes that separate competence levels at A1 and A2 were mean sentence and T-unit length whereas at B1 and B2 the significant indexes were the number of modifiers per noun phrase.

### 2.3. Relationship between syntactic complexity and lexical complexity

Within the CDST approach, a number of studies address the relationship between syntactic and lexical complexity: Verspoor et al. (2008) in a longitudinal study of an advanced L2 English learner over a period of three years, found evidence for a competitive relationship between lexical complexity measured by type-token ratio and syntactic complexity measured by sentence length. Further investigating the same corpus as Verspoor et al. (2008), Schmid et al. (2011) report that syntactic complexity evolves before lexical complexity first through increased use of finite dependent clauses (adverbial, relative and nominal dependent clauses), later replaced by longer non-finite constructions and longer noun phrases. On the contrary, a study with L2-English subjects by Caspi (2010) pointed to lexical complexity as a precursor to syntactic complexity.

A number of studies have shown a parallel increase of both syntactic and lexical complexity: Verspoor et al. (2012) found an increase in the number of subordinate clauses and in the number of sophisticated words in the writing of a group of Dutch learners of English across five levels of proficiency (from absolute beginners to high intermediates). In a similar study by Penris and Verspoor (2017), almost all the syntactic and lexical measures used had a significantly higher average in phase 2 (between C1 and C2) while they decreased towards the end of phase 1 (between B2 and C1). Nevertheless, at one point, syntactic complexity remained the same and lexical complexity continued increasing.

In sum, the review of the literature above shows some issues that call for further research: 1) Regarding in the first place the relationship between syntactic and lexical complexity and L2 writing quality, it is unclear whether subordination and the length of sentences are significant indicators of writing quality. Concerning lexical complexity, conflicting findings are evident as both positive and negative correlations have been found between writing quality and lexical richness, diversity and sophistication (Bulté & Housen, 2014; Yang et al., 2015).

2) Contradictory findings can be found regarding the question of whether lexical complexity and syntactic complexity progress at the same time or not: a parallel development found in Verspoor et al. (2012) and Kim (2014) coexist with findings pointing to syntactic complexity progressing before lexical complexity (Schmid et al., 2011) and the opposite (Caspi, 2010; Mazgutova & Kormos, 2015; Penris & Verspoor, 2017). These

contradictory findings evince the need for further studies that address this issue.

Overall, the studies reviewed before suggest that complexity is an effective discriminator of study stages and proficiency levels. Our study follows this research trend but with important distinctions. First, previous research has mainly examined syntactic complexity while the association between lexical complexity and L2 writing proficiency has been less frequently addressed. The present study addresses lexical complexity and its interaction with syntactic complexity at different proficiency levels. Second, most studies focused specifically on phrasal complexity have addressed the relationship between this subcomponent of syntactic complexity and L2 proficiency through holistic measures (e.g., complex nominals per clause and complex nominals per T-unit). Our study includes a set of grammatical features related to noun phrases, thus combining both holistic and fine-grained measures which will make this a more comprehensive approach to the question. Finally, this study intends to unveil if there is more variation in complexity in higher levels of proficiency as the literature suggests that learners tend to converge more at the advanced level. As studies from the CDST perspective are supposed to show “change over time”, it would be an interesting contribution to compare the findings in the current cross-sectional study with those of longitudinal ones at the same proficiency level.

### 3. Study

Considering the purposes mentioned above, this study will address the following set of research questions:

Research Question 1: Which syntactic and lexical complexity measures correlate with L2 writing quality?

Research Question 2: Is there a significant difference in the syntactic and lexical complexity among essays written by college-level L2 students at different proficiency levels?

Research Question 3: is there a significant difference in the use of noun modifiers among essays written by L2 students at different proficiency levels?



### 3.1. Participants

The participants were 164 first-year students from a degree in Chemistry at a Spanish university. They were all part of an EMI programme. To enrol in the pathway programme in English, candidates must accredit a B1 level of the English language. The participants' CEFR level was based on the scores obtained in an Oxford Placement Test, a test that consists of two sections: The first section measures grammatical and pragmatic knowledge while the second section is designed to measure the test takers' listening ability. According to the scores obtained in the Oxford Placement Test, a total of 22 students were at B1, 84 were at B2 and 58 at C1 as per CEFR. The participating students' proficiency level according to CEFR will be used as evidence of their proficiency levels.

### 3.2. Procedure

For the present study, students had to write an expository essay on the following topic related to their field of study: "Explain the impact of acid rain on the immediate environment and the plants". This was a general, not a guided writing task. Students had to write an essay during a class session and the piece of writing was part of the curriculum in their course. All the participants were given 45 minutes to complete the writing activity. In this way, both time and topic constraints were controlled in order to make results comparable (Wolfe-Quintero et al., 1998).

### 3.3. Measures

The data for this study consists of 164 compositions: 22 compositions at B1, 84 at B2 and 58 at C1 as per CEFR. The compositions or essays were evaluated by means of both global ratings of writing quality as well as by a selection of quantitative measures of different aspects of L2 complexity.

For the global ratings, we used an analytic scale adapted from Connor-Linton and Polio (2014) as it was appropriate for the context of our study and the task carried out since it was based on a detailed analysis of each composition. It included five different features: Content, Organization, Language Use, Vocabulary and Mechanics (for a detailed description of the scale, see Connor-Linton & Polio, 2014, p. 8). The global composition score was obtained by calculating the mean of the five features. Scores from 0 to 10 representing writing quality were assigned to the essays.

Regarding L2 complexity measurement, we calculated a total of seven complexity measures, five gauging different aspects of syntactic complexity, and two gauging lexical complexity. With respect to syntactic complexity measurement, following Norris and Ortega’s (2009) claim that syntactic complexity should be operationalized as a multidimensional construct, the present study incorporates measures that cover the three levels of syntactic analysis. Table 1 lists the five measures of syntactic complexity chosen adapted from Bulté and Housen (2014, 2018). Complexity at the sentential level was measured by means of mean length of sentence, as well as by means of clausal coordination, and clausal subordination. Complexity at the clausal level was measured by calculating the mean length of finite clauses. Finally, complexity at the phrasal level was measured by calculating the mean length of noun phrase.

<b>Syntactic sentential complexity</b>	Mean length of sentence (words/sentence) Clausal coordination (coordinated clauses/sentence) Clausal subordination (dependent clauses/clause)
<b>Syntactic clausal complexity</b>	Mean length of finite clause (words/finite clauses)
<b>Syntactic phrasal complexity</b>	Mean length of noun phrases (words/noun phrases)

Table 1. Syntactic complexity measures (adapted from Bulté & Housen, 2014, 2018).

Moving on to lexical complexity measurement, the two measures of lexical complexity target two related but distinct aspects of lexical complexity: lexical diversity and lexical richness.

The diversity index D (Malvern et al., 2004) was used as an index of lexical diversity or variety in the use of word types. It provides an indication of the degree of words’ repetition in a text.

The index of Guiraud G (Guiraud, 1959) was selected as an index of lexical richness. It indicates variation in, and number of word types used. It captures both diversity and productivity, and it is a complement to the diversity index.

<b>Diversity index (D)</b>	Lexical Diversity: diversity/variation in the use of word types (lemmas)
<b>Guiraud index (G)</b>	Lexical Richness: variation in and number of word types used

Table 2. Syntactic complexity measures (Bulté, 2014 & Housen).

A follow-up analysis of nine specific types of nominal modifiers is presented as well. These grammatical features of interest have been obtained through

an analysis of the three corpora (i.e., essays written by L2 learners at different proficiency levels). The following table shows the nine noun modifiers along with examples from the B1, B2 and C1 corpora.

Noun modifiers	Examples from the corpora
Attributive adjectives	Vast range of factors (B2)
Relative clauses	Approaches that include only basic factors (B1)
Pre-modifying nouns	Rainforest protection (B2)
Possessive noun as pre-modifiers	Experts' points of view (B1)
Prepositions as noun post-modifiers	Significant effects on the environment (B2)
-ed participles as post-modifiers	Information obtained from the participants (B2)
-ing participles as post-modifiers	Outcomes representing several approaches (C1)
Attributive adjectives/ nouns as pre-modifiers	Initial acid rain experiments (C1)
Complement clauses controlled by nouns	The fact that acid rain has a disastrous effect on plants (C1)

Table 3. Noun phrase modification and examples from corpora.

### 3.4. Data analysis

All essays were analysed manually for both the holistic ratings of writing quality and for the calculation of the quantitative measures by two researchers, the author of this study and a lecturer in the subject Academic English with wide experience in rating essays. All the texts were analysed by both lecturers. The annotation took 10-15 minutes per essay on average. A comparison between scores was carried out. In the event of disagreement, the two raters discussed the score assigned by each one of them to reach agreement.

These two researchers are relatively reliable regarding the rating of the quality of the writings with the scales listed above: intra-rater reliability coefficients, based on the correlation between a set of compositions read twice by one reader, range from a low of .875 to a high of .947. Inter-rater reliability coefficients, based on the correlations between the scores assigned to a certain set of compositions read by two researchers, range from a low of .752 to a high of .943. These results indicate high consistency in rating writing quality.

### 3.5. Statistical analysis

A statistical analysis was carried out with the programme R Development Core Team 2018, 3.4.4. version. Pearson's product-moment correlations between syntactic/lexical complexity indexes and writing scores were calculated to identify the relationship between syntactic/lexical complexity

and the quality of the essays (Research Question 1). In order to investigate whether any differences existed in the L2 writings of the L2 learners (Research Questions 2 and 3), we calculated mean scores and standard deviations, and used ANOVA tests and Kruskal-Wallis tests to check for the significance of the differences observed. The use of one test or another depended on whether the hypotheses of normality were verified. In order to study differences in the use of noun modification features, the three corpora written by L2 learners at different proficiency levels were compared in terms of the frequency of the different noun phrase modification structures. To ensure comparability, frequency counts in each individual text were subsequently normalized to 50 words. This made it possible for us to compare our findings with those of other studies. In addition, it allowed us to use parametric statistical tests to compare the means for each feature across the three corpora. A one-way ANOVA test with a Bonferroni post hoc adjustment (to statistically account for multiple comparisons) was used to compare each feature across the three corpora. We regard as statistically significant differences those in which p-value was lower than 0.05.

## 4. Results

Results will be presented in relation to each Research Question formulated.

Research Question 1: Which syntactic and lexical complexity measures correlate with L2 writing quality?

An aim of this study was to find out how the different objective complexity metrics correlated with the scale-based rating of writing quality. As we can see in Table 4, significant positive correlations (shown in the Table with an asterisk) were observed between the scores on the compositions and three of the syntactic complexity metrics: mean length of noun phrase, clausal subordination and mean length of sentence. Non-significant correlations characterised the relationships between writing scores and two metrics, clausal coordination and mean length of finite clause. As regards lexical complexity, a significant correlation was found between both the Diversity index (D) and the Giraud index (G) of lexical complexity and the writing scores.

Complexity measures	R (Correlation Coefficient)	P value
Mean length of sentence	0.157	0.035*
Clausal coordination	0.068	0.361
Clausal subordination	0.219	0.003*
Mean length of finite clause	0.006	0.938
Mean length of noun phrase	0.445	0.001*
The index of Guiraud G	0.824	0.001*
The diversity index D	0.724	0.005*

Table 4. Correlations between complexity measures and writing scores.

Research Question 2: Is there a significant difference in the syntactic and lexical complexity among essays written by college-level L2 students at different proficiency levels?

The second Research Question aimed to determine the complexity metrics that distinguish between proficiency levels. Table 5 shows the mean for each measure used in the three corpora, i.e., the essays by students at B1, B2 and C1. We observe an increase in the mean length of sentence, mean length of clause, mean length of noun phrases and clausal coordination across all proficiency levels. Meanwhile, the amount of subordination progresses from B1 to B2 but remains the same thereafter. As regards lexical complexity, both indexes increase across all proficiency levels.

Complexity measures	B1			B2			C1		
	Mean	Median	S.D.	Mean	Median	S.D.	Mean	Median	S.D.
Mean length of sentence	19.51	17.84	5.23	21.46	19.07	15.53	21.31	20.70	4.85
Clausal coordination	0.59	0.53	0.27	0.62	0.52	0.54	0.63	0.60	0.29
Clausal subordination	0.45	0.33	0.32	0.37	0.37	0.13	0.37	0.37	0.12
Mean length of clause	8.79	8.81	2.07	9.98	8.40	2.03	10.94	9.85	6.86
Mean length of noun phrase	2.61	2.56	0.39	2.71	2.62	0.38	2.93	2.81	0.41
The index of Guiraud G	3.06	3.16	0.52	3.93	3.73	0.90	4.79	4.55	0.68
The diversity index D	3.01	3.11	0.51	3.90	3.73	0.80	4.69	4.55	0.58

Table 5. Complexity measures in essays across proficiency levels: results from the essays by students at B1, B2 and C1.

The next table (Table 6) shows the differences in the complexity measures between proficiency levels. With respect to syntactic complexity, a significant difference was found only for mean length of noun phrase. This significant difference occurred between two pairs: B1/C1 ( $p=0.018$ ) and B2/C1 ( $p=0.045$ ). Meanwhile, the other measures did not change in a statistically significant way.

Regarding lexical complexity, we found significant differences for both the diversity and the richness indexes between all the pairs of proficiency levels: B1/C1 ( $p=0.001$ ), B1/B2 ( $p=0.001$ ), and B2/C1 ( $p=0.002$ ).

Complexity measures	B1 vs B2	B2 vs C1	B1vs C1
Mean length of sentence	-	-	-
Clausal coordination	-	-	-
Clausal subordination	-	-	-
Mean length of finite clause	-	-	-
Mean length of noun phrase	-	*	*
The index of Guiraud G	*	*	*
The diversity index D	*	*	*

Table 6. Differences in the complexity measures in essays across proficiency levels: results from the essays by students at B1, B2 and C1.

Research Question 3: is there a significant difference in the use of noun modifiers among essays written by L2 writers at different proficiency levels?

Table 7 and 8 below present the number and frequency of each type of noun phrase modifier in the three corpora. As shown in the tables, the most common types of noun pre-modifiers in the three corpora are attributive adjectives and nouns; prepositional phrases are the most common types of noun post-modifiers in the three corpora.

Nominal modifiers	Num. of features
Attributive adjectives	1061
Relative clauses	62
Pre-modifying nouns	286
Possessive nouns as pre-modifiers	21
Prepositions as pre-modifiers	241
-ed participles as post-modifiers	44
-ing participles as post-modifiers	8
Attributive adjectives/ nouns as pre-modifiers	42
Complement clauses controlled by nouns	13

Table 7. Number of nominal modifiers for B1, B2, and C1 groups.

Nominal modifiers		Mean	Median	Std. Deviation
Attributive adjectives	B1	1.84	1.72	1.21
	B2	2.27	2.41	1.12
	C1	2.12	2.31	0.79
Relative clauses	B1	0.07	0.00	0.23
	B2	0.21	0.00	0.32
	C1	0.22	0.00	0.19
Nouns as pre-modifiers	B1	0.35	0.19	0.48
	B2	0.78	0.76	0.70
	C1	0.93	0.74	0.67
Possessive noun as pre-modifiers	B1	0.02	0.00	0.12
	B2	0.04	0.00	0.13
	C1	0.09	0.00	0.22
Prepositions as noun post-modifiers	B1	0.38	0.31	0.45
	B2	0.47	0.34	0.54
	C1	0.56	0.50	0.48
-ed participle as post-modifiers	B1	0.06	0.00	0.20
	B2	0.09	0.00	0.21
	C1	0.18	0.00	0.26
-ing participle as post-modifiers	B1	0.01	0.00	0.09
	B2	0.01	0.00	0.06
	C1	0.05	0.00	0.17
Attributive adjectives+nouns as pre-modifiers	B1	0.02	0.00	0.08
	B2	0.14	0.00	0.35
	C1	0.23	0.13	0.28
Complement clauses controlled by nouns	B1	0.01	0.00	0.09
	B2	0.03	0.00	0.11
	C1	0.09	0.00	0.20

Table 8. Nominal modifiers for B1, B2, and C1 groups.

A comparison of the use of the most common patterns of phrasal modification across the three groups of compositions is summarised in Table 9.

Nominal modifiers	B1 vs B2	B2 vs C1	B1 vs C1
Attributive adjectives/nouns as pre-modifiers	-	*	*
Nouns as pre-modifiers	*	-	*
Complement clauses controlled by nouns	-	*	*
Relative clauses	*	-	-
Possessive nouns as post modifiers	*	-	-
-ed participle as post-modifiers	-	-	*
-ing participle as post-modifiers	-	-	-
Attributive adjectives	-	-	-
Prepositions as post-modifiers	-	-	-

Table 9. Differences in the mean frequencies of noun modifiers across proficiency levels.

Statistically significant differences were found in the mean values of six noun modifiers. The first significant difference turned out to be in the use of adjective/noun combinations as pre-modifiers. Results pointed to a significant difference between the B2/C1 ( $p < 0.001$ ) and B1/C1 ( $p < 0.001$ ) groups.

The second observed difference was in the use of nouns as pre-modifiers, with statistically significant differences found between the B1/B2 ( $p < 0.001$ ) and the B1/C1 groups ( $p < 0.001$ ).

The use of Complement clauses controlled by nouns was the third feature to yield significant differences between the three groups. The C1 group (M 0.09) used complement clauses controlled by nouns significantly more than both the B2 (M 0.03;  $p = 0.035$ ) and the B1 groups (M 0.01;  $p = 0.005$ ). On the contrary, no significant difference was observed between the B1/B2 groups.

Significant differences are also observed in the use of relative clauses. Results pointed to a significant increase from the B1 to the B2 groups ( $p < 0.001$ ) while the difference between the B2/C1 and B1/C1 groups did not turn out to be significant.

The use of possessive nouns as post-modifiers was the fifth feature to produce significant differences in our study. The difference between the B1/B2 groups was significant ( $p < 0.008$ ) for this feature, while the results did not reveal any significant difference between the B2/C1 and B1/C1 groups.

Finally, significant differences are also observed in the use of *-ed* participles as post-modifiers. The difference between the B1/C1 groups was significant ( $p < 0.006$ ) for this feature, while the results did not reveal any significant difference between the B2/C1 and B1/B2 groups.

In summary, out of the 9 types of noun modifiers examined in our study, B1 and B2 students did not differ significantly from the more competent students, C1 students in producing 5 of the categories. In addition, compositions by B2 students better approximated those of C1-level writers. In other words, of the six categories that turned out to be significantly different across the three groups, the B2 group of students, when compared to advanced writers, only lacked adjective/noun sequences as pre-modifiers and complement clauses controlled by nouns. The compositions by the B1 group, on the other hand, fell short in four features when compared to the C1 group.

## 5. Discussion

This study has shown a significant link between writing quality and syntactic complexity, corroborating a research trend that has shown a positive relationship between writing quality scores and three syntactic complexity metrics, mean length of sentence, subordination and mean length of noun



phrases (Flahive & Snow, 1980; Homburg, 1984; Casal & Lee, 2019), and two complexity metrics, lexical richness and diversity (Bulté & Housen, 2014; Yang et al., 2015).

A relevant finding, confirming previous results obtained in a secondary education context by the author of the present study (Lahuerta, 2018), was a significant relationship between writing quality and complexification at multiple levels of syntactic organisation: the sentential, the clausal, and the phrasal level. Thus, the use of longer sentences and noun phrases and the use of subordination contribute significantly to assessed writing quality.

Results also revealed a significant relationship between writing quality and both the lexical diversity and lexical richness indexes. The variety of words and the use of many different words in an essay are seen as indicators of higher writing quality. These findings agree with those by Mazgutova and Kormos (2015), who showed how the lexical variation of the academic writing of EFL college learners improved over the course of time, which contributed to essay quality. They partially agree with results by Bulté and Housen (2014), who found a strong correlation between lexical richness and writing quality but not between lexical diversity and writing quality.

Lexical complexity showed significant progress across all proficiency levels. The progress of lexical growth from early competence stages is not matched by an increase in syntactic indexes. In line with findings by Mazgutova and Kormos (2015), only phrasal complexity increases in a significant way; in our study, this progress occurs at later stages of development, B2 and C1. One can say, in light of the results, that lexical complexity increases before syntactic complexity and seems to pave the way for advanced syntactic structures. This agrees with studies within the CDST approach (e.g., Penris & Verspoor, 2017), which showed that between C1 and C2 syntactic complexity levelled off and lexical complexity kept increasing.

Regarding phrasal complexity, findings show that phrasal elaboration is an important source of complexification at the advanced competence levels: this study demonstrates that at more advanced competence levels more phrasal constructions can be observed in L2 academic writing. Results corroborate those of Ai and Lu (2013), Yoon (2017), Jiang et al. (2019), Lan et al. (2019), and Khushik and Huhta (2022), who demonstrated that advanced L2 students produced more noun phrase-related features.

Regarding the distributional patterns of noun modifiers, our study has shown a preference for attributive adjectives and nouns as pre-modifiers and

prepositional phrases as post-modifiers in the three competence levels. Biber et al. (1999) argued that noun phrases with nouns and adjectives as phrasal pre-modifiers and prepositional phrases as post-modifiers are highly characteristic features of both L1 and L2 academic texts.

Some other studies have also shown that these three kinds of noun modifiers are frequent in written academic English. For example, Taguchi et al. (2013) found that the writing of their more proficient group contained a greater number of pre-modifying attributive adjectives and post-modifying prepositional phrases. Staples and Reppen (2016, p. 18) pointed out that “pre-modifying adjectives and nouns have been associated with higher proficiency and higher writing quality in L2 academic writing”. Ansarifar et al. (2018, p. 64) reported that the most common types of noun pre-modifiers in their three corpora (MA students, PhD students, and published expert writers) “were attributive adjectives and nouns, while prepositional phrases were the most common form of post-modification”.

The use of attributive adjectives was not significantly different across the three groups. This result agrees with Biber et al.’s (2011) hypothesized stages of development in writing complexity, according to which this feature is acquired during the early stages of syntactic development. In line with this prediction, we found that B1 students used it as much as B2 and C1 students did. Differences among the compositions were found in the use of pre-modifying nouns: they were significantly more frequent in C1 and B2 compositions compared to B1 compositions. This result tallies with previous studies in which more advanced students used nouns as pre-modifiers significantly more than their lower-level counterparts (e.g., Ansarifar et al., 2018; Parkinson & Musgrave, 2014).

A modifier which was significantly different across the groups was the use of adjective/noun sequences as noun pre-modifiers with the C1 compositions including significantly more instances of this feature than the B1 and B2 compositions. This is in line with findings by Biber et al. (2011), who noted that more frequent use of these phrasal modifiers is characteristic of advanced levels, and it also coincides with results by Ansarifar et al. (2018, p. 68), who found a larger amount of adjective/noun combinations as phrasal noun pre-modifiers in the academic writing of more competent writers.

Differences among the compositions were also found in the use of complement clauses controlled by nouns as the C1 group of students used significantly more complement clauses controlled by nouns than the B2 and

B1 groups. This finding is in line with Biber et al.'s (2011) model according to which this feature is acquired during the last stages of syntactic development and is, therefore, frequently found only in compositions written by advanced writers.

This study has shown that as L2 writers' English competence increases so does their capacity to use more complex phrasal complexity features in academic writing. Thus, adjective/noun sequences as pre-modifiers and complement clauses controlled by nouns were the only two modifiers that turned out to be significantly different between B2 and C1 students. This finding corresponds to Biber et al.'s (2011) developmental index of noun phrase modification that places these two categories at later stages of L2 development.

In addition, B1 and B2 compositions differed significantly in three features, pre-modifying nouns, relative clauses, and possessive nouns as post modifiers which again supports Biber et al.'s (2011) index, according to which these categories are predicted to be acquired at intermediate stages of development. This shows a trend characterised by the use of more complex noun phrases in the writing of L2 college-level students at higher competence levels.

Finally, our study confirms results by the CDST approach in several ways: at C1 syntactic and lexical complexity are not synchronous, as syntactic complexity remains stable while lexical complexity continues increasing; in addition, measures used were higher at advanced proficiency levels, with longer noun phrases, and more lexical diversity and lexical richness.

## 6. Conclusions

This study examined both syntactic and lexical complexity through multiple measures to understand L2 learners' writing development. Interesting findings are the following: While subordination is a significant indicator of writing quality, coordination contributes little or non-significantly to the perception of general writing quality.

The degree of phrasal elaboration can be considered a significant indicator of proficiency.

Both the diversity and richness indexes are significant indicators of proficiency, a novel finding in the literature.

A trend characterised by greater use of complex phrasal constructions in the writing of more competent university students is revealed, pointing to the need for more research to determine the exact sequence of use of these categories at the different competence levels.

All these results must be seen in the light of the EMI context in which the study is carried out, involving Spanish and English. Findings call for a heightened focus on language on the part of both content teachers and students. We believe that both teachers and L2 writers are likely to benefit from an increased awareness of the appropriateness and functions of particular complex structures, specifically of noun phrases in academic writing, as this study's findings show the relevant function of noun phrase complexity in English academic writing overall. In our view, such awareness can be achieved by means of explicit teaching of the linguistic options available in producing noun phrases as well as an analysis of noun phrases in real writing, that is writing with an actual purpose or goal.

The present study has some limitations that should also be addressed in future studies. Thus, the labor-intensive nature of manual coding prevented us from exploiting a larger corpus. We only analyzed L1 Spanish university students' writing samples from the discipline of Chemistry. It would be interesting if future research were to examine the dynamics of syntactic and lexical complexity in the writing of students across other disciplines. This would allow us to investigate the effect of disciplinary variation on students' L2 writing development.

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