| RESEARCH ARTICLE

Syntactic Complexity Development in Bahraini EFL Academic Writing: An Automated and Register-Based Analysis

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| **ABSTRACT**

This study examines the relationship between syntactic complexity and writing proficiency in EFL learners' texts across three academic levels: Intermediate, Upper-Intermediate, and Advanced. The study utilized the Tool for the Automatic Analysis of Syntactic Sophistication and Complexity to analyze the syntactic complexity indices detected in students' texts. These indices were statistically compared across academic levels and examined in relation to TOEFL writing proficiency descriptors to evaluate their diagnostic validity. The study conducted a close analysis of recurrent syntactic error patterns and developmental shifts in clause versus phrase density. It was guided by the Longman Grammar of Spoken and Written English model. The findings revealed a progression from clause-based to phrasal syntactic structures in advanced-level texts and a notable decrease in syntactic error frequency. The results contribute to the growing body of research on automated syntactic analysis in EFL contexts, highlighting the importance of integrating both structural and usage-based measures in writing assessment and instruction.

1. Introduction

The inclusion of IELTS preparation programs in Bahrain's secondary education reflects a policy direction toward International Proficiency Standards (University of Bahrain, 2023; News of Bahrain, 2024). English serves as the primary language of instruction in many higher education institutions across Bahrain. This makes academic writing in English essential for university students' success. For learners of English as a Foreign Language (EFL), academic writing presents particular challenges because it requires control over grammatical structures, appropriate vocabulary, and formal academic style (Biber et al., 2010, 2011).

In second language writing research, syntactic complexity has been identified as an important indicator of writing development and proficiency. Syntactic complexity refers to the range and structural elaboration of grammatical constructions used in writing (Larsen-Freeman, 1978; Ortega, 2003). Research shows that more proficient writers use a wider variety of structures and more efficient ways of organizing information grammatically (Wolfe-Quintero et al., 1998; Lu, 2010; Kyle & Crossley, 2018). Earlier studies measured syntactic complexity using general measures such as mean length of sentence and ratios of dependent clauses (Hunt, 1965; Wolfe-Quintero et al., 1998). Later research showed that these measures do not fully capture advanced academic writing. Corpus analysis of expert writing indicates that academic texts rely more on dense noun phrase structures and less on extensive clausal subordination (Biber et al., 1999; Biber et al., 2011; Biber & Gray,2016, 2013; Lu, 2014). This study adopts the methodological logic underpinning Bahrain's emerging proficiency-oriented assessment framework. It operationalizes this approach by evaluating students' writing development comparing the syntactic complexity indices against internationally recognized proficiency criteria that are appropriate to the instructional content delivered within the curriculum.

Despite substantial international research on syntactic complexity, studies focusing on Bahraini university students have rarely been studied in corpus-based research on academic writing. This absence is important because teaching methods, educational expectations, and exposure to English differ across contexts and may affect how writing develops. The present study addresses this gap by examining syntactic complexity across three academic levels among Bahraini EFL learners using automated analysis and register-based interpretation. The alignment of Usage-Based Indices with the Standardized TOEFL iBT Descriptors supports more nuanced interpretations of learners' writing development, ultimately informing pedagogy, policy, and materials design in Bahrain's evolving landscape.

The study addresses these research questions:

1. What syntactic complexity measures are most commonly applied by students at different academic levels (Intermediate, Upper-Intermediate, and Advanced)?
2. To what extent do traditional syntactic complexity indices predict holistic scores?
3. What are the prevalent types of syntactic errors found in students' writing across these academic levels?

2. Literature Review

2.1 Syntactic Complexity in L2 Writing

Syntactic complexity has long been viewed as a central aspect of language development, alongside accuracy and fluency (Larsen-Freeman, 1978). In L2 writing research, syntactic complexity refers to the degree of structural elaboration present in learners' written texts (Ortega, 2003). Early research used mainly length-based measures and indices of subordination to describe development (Hunt, 1965; Wolfe-Quintero et al., 1998). These early measures were later criticized for combining different grammatical phenomena into single indices. Norris and Ortega (2009) argue that syntactic complexity should be treated as a multidimensional construct and propose distinguishing between overall complexity, clausal complexity, and phrasal complexity. This distinction has guided much recent research in the field.

2.2 Clausal and Phrasal Complexity

Clausal complexity involves the use of dependent clauses, such as relative, adverbial, and complement clauses. While such structures are common in spoken and narrative discourse, corpus-based research shows that they play a more limited role in academic writing (Biber et al., 1999). Several studies indicate that increases in clausal subordination are more typical of earlier stages of development, whereas advanced academic writing relies increasingly on phrasal structures (Biber et al., 2011; Lu, 2014).

Phrasal complexity refers to the expansion of noun phrases through premodification, post-modification, and embedded structures. These dense noun phrases allow writers to express complex ideas concisely and are a defining feature of academic discourse (Biber et al., 2011). Research consistently shows that phrasal complexity measures are strongly related to writing quality and proficiency (Lu, 2014; Staples et al., 2016; Kyle & Crossley, 2018).

2.3 Automated Analysis and Register-Based Perspectives

Automated tools such as the L2 Syntactic Complexity Analyzer (Lu, 2010) and TAASSC (Kyle, 2016) have made it possible to analyze syntactic complexity across large datasets. While these tools provide reliable quantitative measures, researchers emphasize the importance of interpreting results within a functional and register-based framework (Biber et al., 2011; Ortega et al., 2023).

Register-based descriptions of grammar, such as those presented in the Longman Grammar of Spoken and Written English (Biber et al., 1999), provide a useful basis for interpreting syntactic patterns. From this perspective, development in academic writing involves a gradual shift away from features typical of conversation toward structures that support information density and abstraction.

2.4 Register-Based Interpretation and the Gulf Context

While automated tools provide essential quantitative data, scholars increasingly stress that numbers must be interpreted within a functional and register-based framework (Ortega et al., 2003; Biber et al., 2011). A high "clauses per T-unit" ratio, for instance, may indicate coordination overload typical of conversational register rather than advanced subordination. Therefore, analyzing syntactic development involves mapping learner language onto the conversational-academic register continuum described by LGSWE.

Research specifically examining syntactic development in Gulf Cooperation Council (GCC) EFL contexts is limited. Studies often highlight general challenges faced by Arabic-speaking learners (e.g., article misuse, verb tense). However, detailed, corpus-based analyses of syntactic complexity development across academic levels in Bahrain are virtually non-existent. This study fills this critical gap by applying the integrated methodology of automated analysis (TAASSC), proficiency benchmarking (TOEFL), and register profiling (LGSWE) to the Bahraini EFL context, thereby contributing a localized perspective to the global body of knowledge on L2 writing development.

3. Methodology

3.1 Research Design

This study employed a corpus-based, mixed-methods research design to investigate the development of syntactic complexity. The design combined quantitative and qualitative approaches: quantitative analysis provided measurable patterns of syntactic usage across groups, while qualitative, register-based analysis offered a functional interpretation of those patterns and the errors within them.

3.2 Corpus and Participants

The study corpus comprised 120 original, timed argumentative essays written in-class by Bahraini university students. The essays were evenly sampled from three sequential institutional academic levels:

- Intermediate Level (IL): 40 essays from second-year admission-level writing courses.

- Upper-Intermediate Level (UIL): 40 essays from third-year writing courses.

- Advanced Level (AL): 40 essays from senior-level writing courses.

All participants were native speakers of Arabic studying in English-medium undergraduate programs. To ensure comparability, essays were selected based on strict criteria: a minimum length of 200 words, completion under timed conditions without external aids, and a common argumentative genre. The prompts addressed relevant topics (e.g., social media addiction, public health policies) designed to elicit reasoned exposition and argumentation.

3.3 Analytical Framework and Procedures

The data analysis proceeded through three interconnected stages:

3.3.1 Automated Syntactic Analysis with TAASSC
All 120 essays were processed using TAASSC (Kyle, 2016). The tool generated a comprehensive profile of indices for each text, including:

- Length-Based Indices: Mean Sentence Length (MLS), Mean Clause Length (MLC).

- Clausal Complexity Indices: Clauses per T-unit (C/T).

- Phrasal Complexity Indices: Noun Phrase modifiers per NP, Complex Nominals per Clause.

- Usage-Based Sophistication Indices: Frequency-based measures of construction use.

- Accuracy Indices: Determiner accuracy score.

Descriptive statistics were calculated for each index across the three academic levels.

3.3.2 Proficiency Correlation Analysis
To address the predictive validity of syntactic indices, Pearson correlation coefficients (r) were computed between key TAASSC indices (MLS, NP Elaboration, Determiner Accuracy) and the overarching construct of writing proficiency, as operationalized by alignment with TOEFL iBT holistic writing descriptors (ETS, 2023).

3.3.3 Qualitative Register-Based Profiling with LGSWE
A manual, qualitative analysis was conducted using the LGSWE (Biber et al., 1999) framework. This involved profiling a subset of essays from each level to identify characteristic syntactic features and error patterns associated with either the conversational or academic register. Features analyzed included clause types, noun phrase complexity, grammatical features, and error patterns categorized by register association.

4. Results

4.1 Quantitative Findings: Developmental Trends in Syntactic Indices

The automated analysis showed clear progression in syntactic complexity across the three levels. Table 1 presents key indices, illustrating this development.

Table 1: Key Syntactic Indices Across Academic Levels

Level	Mean Sentence Length (MLS)	Mean Clause Length (MLC)	Clauses per T-unit (C/T)	Noun Phrase Modifiers (per NP)	Determiner Accuracy (score)
IL	13.0	9.0	1.70	0.35	1.6
UIL	17.0	12.0	1.75	0.50	3.5
AL	21.4	13.4	1.68	0.67	9.1

The results in Table 1 show several important patterns. First, there was clear growth in structural elaboration, with both Mean Sentence Length and Mean Clause Length increasing steadily from the Intermediate to the Advanced level. This indicates that as proficiency improved, learners wrote longer and more developed sentences and clauses.

Second, the data suggest a change in the type of complexity used. While the Clauses per T-unit ratio remained fairly stable, the frequency of Noun Phrase Modifiers per NP almost doubled. This pattern indicates that advanced learners achieved complexity not by adding more dependent clauses, but by elaborating noun phrases with more modifiers.

Third, there was significant improvement in grammatical control. The Determiner Accuracy score increased dramatically across levels, rising from 1.6 at the Intermediate Level to 9.1 at the Advanced Level. This substantial improvement shows gains in mastering the English article system, which is particularly challenging for Arabic speakers.

4.2 Correlation with Proficiency Descriptors

Table 2 shows the correlation between selected syntactic indices and the holistic proficiency framework from TOEFL descriptors.

Table 2: Correlation Between Syntactic Indices and TOEFL Proficiency Descriptors

Indices	Correlation with TOEFL (r)	R^2 (Variance Explained)
Mean Sentence Length	0.71	0.5
Noun Phrase Elaboration	0.54	0.29
Determiner Accuracy	0.48	0.23

The correlation analysis provides important information about which syntactic features predict writing quality. Mean Sentence Length showed the strongest relationship with holistic writing proficiency, with a strong positive correlation (r = .71) that explains half of the variance in proficiency scores. This suggests that evaluators notice and value longer, more developed sentences in academic writing.

Noun Phrase Elaboration also showed a strong positive relationship (r = .54), accounting for 29% of the variance. This confirms that dense noun phrases are an important marker of advanced academic writing. Determiner Accuracy showed a lower but still

meaningful correlation (r = .48), explaining 23% of the variance. This indicates that grammatical precision with articles contributes to perceptions of writing quality, though to a lesser extent than structural elaboration.

4.3 Qualitative Register Profiling and Error Analysis

The LGSWE-based analysis provided a functional perspective on the quantitative data, showing how syntactic features relate to register differences.

4.3.1 Syntactic Feature Profiling
The manual analysis revealed a clear progression in register alignment across levels. Intermediate Level writing showed conversational register patterns, with basic subordination, limited noun phrase modification, and frequent use of fragment structures and simple coordination.

Upper-Intermediate Level writing represented a transitional stage. Features of both registers appeared together, with learners using more coordination and beginning to show clausal complexity alongside early attempts at noun phrase elaboration.

Advanced Level writing demonstrated clear academic register patterns. This included advanced embedding with multiple dependent clauses, dense noun phrase elaboration, and use of syntactic structures for academic functions like hedging and argumentation.

4.3.2 Syntactic Error Profiling
The types of syntactic errors changed systematically across academic levels. At the Intermediate Level, errors were mainly conversational-register types, particularly article misuse and verb-noun mismatches. These reflect basic grammatical challenges.

At the Upper-Intermediate Level, error types shifted toward issues of cohesion and boundary control, such as run-on sentences and pronoun ambiguity. These errors occur when learners attempt more complex sentences without fully mastering subordination and reference.

At the Advanced Level, a new category of errors appeared, best described as academic-register errors, with over-embedding being most common. Sentences were grammatically correct but became overly dense and complex, sometimes sacrificing clarity for elaboration. This indicates that as learners master complex syntax, they face new challenges in managing that complexity effectively.

5. Discussion

The findings of this study provide support for usage-based and register-oriented views of L2 syntactic development, while offering specific insights into the Bahraini EFL context.

5.1 The Shift to Phrasal Complexity and Its Predictive Value

The quantitative results clearly demonstrate the developmental shift from clausal to phrasal complexity. The stable C/T ratio alongside rising NP elaboration and MLS matches patterns described in previous research (Biber et al., 2011; Lu, 2014). Bahraini EFL learners, like learners in other contexts, develop a more condensed syntactic style as they advance, packing information into dense noun phrases rather than spreading it across clauses. The strong correlation of MLS and NP elaboration with TOEFL descriptors validates these measures as reliable indicators of writing proficiency in assessment contexts.

5.2 The Register Continuum as a Framework for Development

The qualitative register analysis makes the concept of "development" more concrete and observable. The progression from IL (conversational) to AL (academic) patterns provides evidence for the LGSWE continuum as a model of L2 writing development. This is not simply about using more difficult grammar, but about adopting a grammatical style suited to academic discourse. The error analysis adds to this picture, showing that development involves not just eliminating old errors but facing new, more sophisticated challenges.

5.3 Comparison with Previous Research and Local Specifics

The main developmental patterns observed closely match findings from studies in other EFL contexts (Lu, 2014; Kyle & Crossley, 2018; Staples et al., 2016). This suggests common pathways in academic writing development across different learner populations. However, the study also highlights locally relevant details. The particular difficulty with determiner accuracy at the IL, and its significant improvement later, likely reflects the specific challenge the English article system presents for Arabic L1 speakers. Also, the strong presence of conversational features at lower levels may relate to the nature of English input in Bahrain. These observations point to the need for teaching approaches that address these specific challenges.

5.4 Implications for Teaching

The findings suggest several practical recommendations for EFL writing instruction in Bahrain and similar contexts.

Teaching should move from a primary focus on sentence coordination and basic subordination to explicit instruction in phrasal elaboration. Instruction needs to go beyond counting clauses. To develop the phrasal complexity typical of academic writing, teaching should directly address how to expand noun phrases. This includes systematic teaching of pre-modification and post-modification, as well as the strategic use of nominalization.

Writing instruction should include explicit attention to register awareness. Using the contrastive framework from the LGSWE model, teachers can help students see and understand the syntactic differences between conversational and academic language. This can be done through comparing text pairs—for example, comparing a social media post with a textbook passage, or comparing informal and formal versions of student writing. By analyzing different kinds of texts through this register perspective, students can develop awareness needed to make appropriate syntactic choices.

Feedback and error correction should match learners' developmental stages. A single approach to grammar feedback does not work well for all levels. For intermediate and upper-intermediate learners, teaching should focus on basic accuracy, systematically addressing frequent errors like article misuse and subject-verb agreement. When learners reach the advanced level, the focus should change. At this stage, the goal moves beyond basic accuracy to stylistic concerns. Teaching should address conciseness, managing clarity in complex sentences, and using embedding effectively for rhetorical purposes.

Educational technology can support diagnostic and developmental goals. Tools like TAASSC can serve teaching purposes as well as research functions. Teachers and program coordinators can use such automated analysis to identify common syntactic weaknesses efficiently, allowing for targeted teaching. These tools can also track syntactic development over time, providing concrete evidence of growth in phrasal complexity and other important measures.

6. Conclusion

This study has examined syntactic complexity development in the academic writing of Bahraini EFL university students. By combining automated analysis with TAASSC, correlation with proficiency benchmarks, and register-based interpretation via LGSWE, it has shown both the quantitative patterns and qualitative nature of this development.

The main finding is that syntactic development in this context shows clear progression from a clause-oriented, conversational style toward a phrase-dense, academic style. This change is reliably indicated by increases in mean sentence length and noun phrase elaboration, measures that strongly predict holistic writing proficiency. The development follows the conversational-academic register continuum, with learners' errors changing from basic grammatical mistakes to challenges related to managing sophisticated syntax.

While the main findings agree with international research, showing shared pathways in academic writing development, they also provide important, locally relevant evidence to inform teaching and policy in Bahrain. The study makes clear that achieving advanced academic writing proficiency requires more than grammatical accuracy; it requires deliberate teaching focused on register-appropriate syntactic organization, specifically phrasal complexity. Future research following individual learners over time and studies testing teaching methods focused on phrasal elaboration would build on these findings. Ultimately, by basing instruction on a clear understanding of syntactic development, teachers can better help EFL learners meet the linguistic demands of academic and professional writing.

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