

Evaluating Corpus-Based Prioritization Criteria for Reporting-Verb Constructions in Computer-Assisted EFL Academic Writing

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Abstract: This study tests how corpus-derived criteria can be combined to prioritize reporting-verb constructions that are both academically distinctive and readily automatable for noticing and data-driven learning (DDL) tasks in computer-assisted EFL academic writing. Using COCA (1990–2019), we contrasted Academic and Newspaper registers to compute register-sensitive normalized frequencies for five target verbs (argue, suggest, indicate, demonstrate, show), estimated dispersion via unique outlet counts in Academic KWIC samples, and coded 35 Academic concordance lines per verb family for phrase-frame stability, focusing on Verb + that-clause reporting patterns and competing procedural/metadiscursive uses. Register-sensitive frequency altered selection relative to Academic-only frequency by flagging *show* as high-frequency but not academically distinctive, while identifying *indicate* and *demonstrate* as strongly concentrated in academic prose. Phrase-frame stability was the decisive implementation criterion: *suggest* and *argue* formed highly stable that-clause templates suitable for lemma-level automation, whereas *indicate* and *demonstrate* required construction-level constraints or multiple templates due to polyfunctionality and complement variation. The findings support a two-stage prioritization logic for CALL task generation: apply register-sensitive frequency as an initial filter, then use phrase-frame stability to select compact, teachable, automatable constructions, with dispersion providing corroborative evidence within sampling limits.

Keywords: data-driven learning; reporting verbs; phrase frames; register sensitivity; CALL

Introduction

The mastery of academic writing is one of the pillars of success of English as a foreign language (EFL) of higher education students, and it is one of the most difficult skills to master because it requires strict control of language, rhetorical skills, and awareness of the genre (Praminatih, 2023; Liardet & Black, 2019). Specifically, the role of reporting-verb constructions, i.e., phrasal units that include such verbs as argue, suggest, or indicate and are followed by complement clauses, is central to the argumentation building, attributing ideas, and evidentiality control in academic texts (Yeganeh & Boghayeri, 2015; Rawlins et al., 2024). These constructions enable writers to dialogically interact with previous research, supporting, entertaining, or attributing claims without compromising their academic position (Liardet & Black, 2019). Nevertheless, EFL learners tend to show little variation in verb reporting, preferring neutral forms that do not contribute to the depth of evaluation and appropriateness of register, which is demonstrated by the analysis of learner productions in the corpus (Mizumoto, 2025; Ren, 2022). This problem is further complicated by the fact that most reporting verbs are polyfunctional and can be used in reporting, procedural, or metadiscursive functions, depending on the context, and thus instructional issues arise around prioritizing teachable targets (Yan et al., 2024).

Theoretical premises to solve these issues are based on systemic functional linguistics and multidimensional analysis (MDA), which focuses on the functional aspects of register variation in academic speech (Sheng & Li, 2024). An example of MDA frameworks, as demonstrated by Biber (1988), prioritizes academic registers in terms of involved versus informational production, narrative versus non-narrative concerns, and overt persuasion. Reporting verbs also play a role in stance markers that align with informational and persuasive dimensions (Boulton & Cobb, 2017; Gries, 2022). The register-sensitive character of linguistic features has been highlighted by recent uses of MDA to academic corpora, demonstrating that academic prose has a preference towards compressed, noun-heavy constructions and not clausal elaboration, which directly influences the distribution of reporting constructions (Sheng & Li, 2024). In applied linguistics and TESOL, this has informed corpus-based methods that utilize large-scale data to identify pedagogically relevant patterns, and has replaced prescriptive grammar rules with inductive discovery (Lu et al., 2018; Zare et al., 2024).

In this regard, data-driven learning (DDL) has become one of the most important pedagogical paradigms, enabling EFL learners to investigate authentic language patterns with the help of concordances and frequency data, and thereby develop metalinguistic awareness and autonomy (Boulton & Cobb, 2017; Wang & Yan, 2025). Meta-analyses support the moderate to large effects of DDL on vocabulary learning, grammatical accuracy, and writing fluency, especially when combined with task-based exercises (Boulton & Cobb, 2017; Zare et al., 2024). DDL tasks that involve reporting verbs in EFL academic writing have demonstrated an increase in lexical diversity and functional appropriateness, as learners are able to identify contextual preferences based on corpus evidence (Liardet & Black, 2019; Mizumoto, 2025). Nonetheless, the effectiveness of DDL depends on the choice of representative and accessible targets, where criteria such as frequency guarantee high-exposure items and dispersion ensure the generalizability of the results to texts (Gries, 2022; Tong et al., 2025).

Computer-assisted language learning (CALL) has further intensified the potential of DDL by enabling the system to automatically highlight patterns in texts, thereby supporting incidental learning (Feroce et al., 2025; Mizumoto, 2025). Interactive DDL exercises, including those with natural language processing, can be generated by CALL tools, which scaffold the use of reporting verbs and adapt to learners' needs, providing immediate feedback (Wang & Yan, 2025). Research in EFL settings demonstrates that these tools can be used to promote interaction and competence, particularly among emergent bilinguals who must work with academic English (Feroce et al., 2025; Zare et al., 2024). These efforts are complemented by phrase-frame stability, which quantifies the repetitive slots of variables (e.g., verb that), and can be used to recognize automatable templates that can be used in CALL implementation, e.g., genre-specific lists of introductions to research articles (Yan et al., 2024; Lu et al., 2018; Ren, 2022).

Although these developments have been made, significant gaps remain in the literature. Although such individual criteria as frequency and dispersion are widely tested in terms of vocabulary selection (Gries, 2022; Tong et al., 2025), there is a lack of studies that combine them in a systemic way to prioritize constructions to be used in automated DDL tasks, especially in EFL academic writing (Boulton & Cobb, 2017; Zare et al., 2024). Reporting verbs, despite being the focus of stance and attribution, are typically studied in isolation, without regard to their phraseological stability or register sensitivity, resulting in suboptimal targets that are either too general or too insufficiently automatable (Praminatih, 2023; Liardet & Black, 2019). Furthermore, the use of single-register analyses overlooks contrastive baselines, which may overvalue high-frequency items with no academic distinctiveness (Yeganeh & Boghayeri, 2015; Rawlins et al., 2024). Although CALL-oriented research has potential, it does not involve decision-based assessments of how these criteria can be combined to produce teachable templates, which prevents the creation of accurate, scalable interventions (Feroce et al., 2025; Mizumoto, 2025).

In this paper, we address these gaps by evaluating corpus-based prioritization criteria on the Corpus of Contemporary American English (COCA), a billion-word corpus spanning 1990-2019 across various registers. Comparing academic and newspaper registers, the analysis measures register sensitivity and proxies for dispersion and phrase-frame coding, considering five pedagogically significant reporting verbs, such as argue, suggest, indicate, demonstrate, and show (Liardet & Black, 2019). This combined strategy aligns with the principles of construction grammar, where families of lemmas are viewed as instructional design units (Lu et al., 2018). Finally, the study aims to inform the CALL task generation by determining representative, regular, and automatable constructions.

The research question is as follows:

1. What corpus-based prioritization measures (frequency, dispersion, phrase-frame stability) used on the COCA are effective predictors of reporting-verb constructions that can be used in automated noticing and data-driven learning activities in computer-assisted EFL academic writing?

Methods

Research design

The research design of this study was corpus-informed and CALL-oriented, whereby corpus evidence was applied to develop explicit prioritization criteria for automated noticing and data-driven learning (DDL) task generation in EFL scholarly writing. The logic behind the decision was that three corpus-based criteria comprising (a) frequency, (b) dispersion, and (c) phrase-frame stability converged to find reporting-verb constructions that are (i) characteristic of academic discourse and (ii) regular enough to be operationalized into teachable, automatable templates.

Data source

All data were accessed through the web interface of the Corpus of Contemporary American English (COCA), a large monitor corpus comprising approximately one billion words from 1990 to 2019, divided into major registers/genres.

Registers and corpus sizes

Two COCA registers were used. The academic register was used as the target criterion for academic prose, and the newspaper register served as a contrastive, informational standard to measure register sensitivity (i.e., a candidate is academically distinctive and not just common in the general writing of the populace). The sizes of register and the number of texts were borrowed in COCA documentation: Academic = 120,988,361 words in 26,137 texts; Newspaper = 122,958,016 words in 90,243 texts.

Target items

Five reporting verbs were selected due to their established relevance to academic stance, evidentiality, and attribution in EFL academic writing instruction: argue, suggest, indicate, demonstrate, and show. The unit of analysis for frequency was the lemma family (i.e., aggregation across inflectional variants), aligning the quantitative evidence with construction-oriented instructional design.

Query procedure and data extraction

Frequency extraction. For each verb, COCA searches were run separately in Academic and Newspaper using the interface's register-limiting ("Sections") feature. The raw total for the verb family (aggregating visible inflections) was recorded for each register.

Concordance extraction (KWIC). To assess phrase-frame stability in Academic, concordance lines were extracted from the Academic register. A platform constraint in the KWIC view required choosing a surface form rather than displaying lemma-level KWIC directly; therefore, concordance sampling was implemented as a pooled lemma-family procedure: for each target, 25 KWIC lines were extracted for the base form (e.g., *argue*) and 10 KWIC lines for a frequent past-tense form (e.g., *argued*), yielding 35 lines per verb family. In the interface, KWIC output was displayed sorted by year; the present sample therefore reflects a late-period slice of COCA (predominantly 2019) and is treated as evidence for frame identification rather than as a basis for population-level distributional inference.

Operationalization of criteria and computations

Criterion 1: Frequency. The normalized frequency per million words (pmw) was computed using COCA register word totals:

$$\text{pmw}_{v,r} = \left(\frac{\text{raw}_{v,r}}{N_r} \right) \times 1,000,000$$

where $\text{raw}_{v,r}$ is the raw count for the verb family v in register r , and N_r is the number of words in register r . Register sensitivity was quantified as the Academic/Newspaper pmw ratio, and its log2 transform:

$$\log_2 \left(\frac{\text{pmw}_{v,\text{Acad}}}{\text{pmw}_{v,\text{News}}} \right)$$

Positive values indicate academic concentration; negative values indicate greater prevalence in newspapers.

Criterion 2: Dispersion. Because a direct range statistic (e.g., number of texts containing the item) was not available in the KWIC output in the used view, dispersion was approximated as a conservative proxy: the number of unique publication outlets represented in the Academic KWIC sample for each verb family (based on outlet labels shown alongside concordance lines). This proxy was used to corroborate that the extracted frames were not confined to a single outlet.

Criterion 3: Phrase-frame stability. Phrase-frame stability was operationalized as the degree to which a verb family yields recurrent, automatable templates suitable for noticing and DDL tasks. Each KWIC line was coded for complement pattern, with particular attention to the reporting-relevant Verb + that-clause construction because of its pedagogical value for academic stance and attribution. A secondary qualitative coding distinguished reporting/evidential uses (e.g., *results indicate that...*) from procedural/metadiscursive uses (e.g., *as indicated in Table...*; *to indicate that...*), as these different functions bear directly on the precision of automated noticing rules.

Analytic integration

The criteria were integrated to answer the research question in a decision-oriented manner. Register-sensitive frequency served as the first-pass filter for academically characteristic candidates; phrase-frame stability served as the second-pass criterion for automatable instructional targeting; dispersion (proxy) served as supporting evidence for generality across academic outlets. The integrated outcome was a ranked set of reporting-verb construction families with implementable construction templates suitable for CALL task generation.

Results

Criterion 1: Frequency and register sensitivity

Table 1 reports raw frequencies, normalized frequencies (pmw), and Academic/Newspaper contrasts for the five reporting verbs. COCA register sizes are drawn from the COCA documentation (English Corpora, n.d).

Table 1. Frequency and register sensitivity in COCA (Academic vs. Newspaper)

Verb	Academic raw	Academic pmw	Newspaper raw	Newspaper pmw	Acad/News ratio	log2(Acad/News)
show	89,965	743.58	102,765	835.77	0.89	-0.17
suggest	63,430	524.27	19,140	155.66	3.37	1.75
indicate	51,397	424.81	7,277	59.18	7.18	2.84
argue	31,543	260.71	14,320	116.46	2.24	1.16
demonstrate	27,928	230.83	4,896	39.82	5.80	2.54

Two findings are central. First, a frequency-only strategy applied within Academic would prioritize *show* as the dominant target (743.58 pmw). Yet *show* is *not* academically distinctive: it is slightly more frequent in Newspaper (negative log2 ratio). Second, the strongest academically concentrated items are *indicate* and *demonstrate*, followed by *suggest*, with *argue* showing a moderate academic skew. Thus, register-sensitive frequency provides a materially different prioritization than Academic frequency alone, demonstrating why the contrastive baseline is necessary for defensible target selection.

Criterion 2: Dispersion (proxy via outlet diversity)

Table 2 summarizes the dispersion proxy for the Academic KWIC samples. Even within a limited, year-clustered concordance slice, each verb family occurred across numerous distinct academic outlets, which supports the interpretation that extracted frames are not idiosyncratic to a single journal.

Table 2. Dispersion proxy for Academic KWIC samples

Verb family (Academic KWIC)	KWIC lines (n)	Unique outlets (n)
argue + argued	35	15
suggest + suggested	35	14
indicate + indicated	35	14
demonstrate + demonstrated	35	18
show + showed	35	15

The dispersion proxy did not sharply differentiate candidates in the way that register-sensitive frequency did; instead, it functioned as a corroboration check that phrase-frames are broadly attested across outlets and therefore plausible as general instructional targets.

Criterion 3: Phrase-frame stability in Academic concordance lines

Phrase-frame stability was examined to determine whether each candidate supports a compact set of recurring templates suitable for automated noticing and DDL activities. Because “that-clause” reporting frames are particularly teachable and straightforward to automate, Table 3 reports the number and share of Verb + that-clause instances in the Academic KWIC samples. For *indicate*, the updated 25th base-form line (*graphs indicate percentage...*) adds further evidence of non-reporting uses competing with inferential reporting uses, which is instructionally consequential for automation precision.

Table 3. Academic KWIC for phrase-frame stability for reporting that-clause frames

Verb family	KWIC n	Verb that (n)	Verb that (%)	Interpretation for automated noticing
suggest + suggested	35	32	91.43	High stability; lemma-level targeting reliably captures inferential reporting frames (<i>findings/results suggest that...</i>)
argue + argued	35	30	85.71	High stability; supports stance-attribution frames (<i>argue that...; it is/has been argued that...</i>)
indicate + indicated	35	18	51.43	Moderate stability; substantial competition from procedural/metadiscursive functions (<i>to indicate...; as indicated...; graphs indicate percentage...</i>)
demonstrate + demonstrated	35	11	31.43	Multi-pattern target; frequent non-that complements (<i>demonstrate + NP; to demonstrate...</i>) require template differentiation
show + showed	35	14	40.00	Heterogeneous; reporting <i>show(ed) that...</i> exists but lemma-level targeting risks many non-reporting uses (display/instruction/procedure)

The KWIC evidence refines the frequency-based ranking in Table 1 in a way that is directly relevant to CALL implementation. *Suggest* and *argue* exhibit strong phraseological concentration around the that-clause reporting frame, making them the most “instruction-efficient” primary targets for automated noticing, because learners can be guided toward a single, high-yield construction family with minimal rule complexity. *Indicate*, while the most academically skewed item in Table 1, is only moderately stable at the lemma level because it frequently appears in procedural and metadiscursive environments (including the added *graphs indicate percentage...* line), implying that automated noticing should target constrained constructions (e.g., evidential subject + *indicate that*) rather than the lemma indiscriminately. *Demonstrate* shows strong academic skew but a comparatively low reliance on the that-clause frame, suggesting that it is best treated as a multi-template target (e.g., *to demonstrate...; demonstrate + NP; demonstrate that...*). Finally, *show* illustrates the core methodological payoff of the criteria approach: it is extremely frequent, but it is neither register-distinctive (Table 1) nor phrase-frame stable at the lemma level (Table 3), so its pedagogical use should be

restricted to explicitly defined reporting frames (e.g., *results show that...*) or used as a contrastive case to raise learners' awareness of polyfunctionality and register risk.

Integrated answer to the research question

To make discrepancies between raw frequency and instructional suitability visible, and to answer our research question, we used a combined numeric–visual encoding figure as a decision matrix. Figure 1 synthesizes the three prioritization criteria into a decision matrix, illustrating how register-sensitive frequency and phrase-frame stability jointly determine the instructional and automational status of each reporting-verb family. The graded color scale and overlaid numeric values (1–5) encode the *relative strength of each verb within each criterion*, where higher values (4–5; warmer tones) indicate stronger alignment with the pedagogical objective represented by that criterion (e.g., academic distinctiveness or phrase-frame regularity) and lower values (1–2; cooler tones) indicate weaker alignment; mid-range values (3) reflect moderate support.

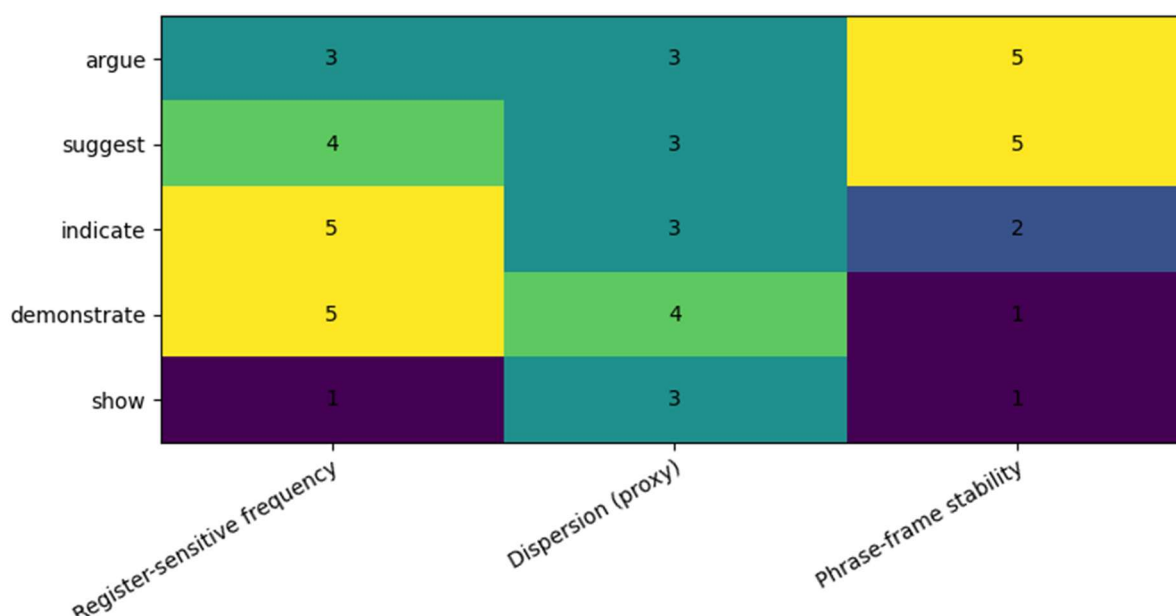


Figure 1. Decision Matrix for CALL-Oriented Prioritization of Reporting Verbs

As illustrated in Figure 1, across the three criteria, the results support a two-stage prioritization logic for CALL-oriented selection of reporting-verb targets. Register-sensitive frequency contrast functions as the most effective first-pass criterion because it identifies academically characteristic candidates and simultaneously flags misleading high-frequency general verbs such as *show*, which receives the lowest score (1) despite its raw prevalence. Phrase-frame stability constitutes the decisive second-pass criterion, as reflected in the highest stability scores (5) for *suggest* and *argue*, indicating that these verbs yield compact, automatable templates suitable for noticing and DDL tasks. In contrast, *indicate* and *demonstrate* receive high frequency scores (5) but markedly lower stability scores (2 and 1, respectively), signaling high academic value accompanied by polyfunctionality that necessitates construction-level constraints or multiple templates. Finally, *show* exhibits consistently low scores (1) across both frequency and stability dimensions, reinforcing that it is best targeted only under strict constructional restrictions despite its high Academic frequency. Dispersion (proxy), represented by largely mid-range scores (3–4) and corresponding coloration, provides supporting evidence that the extracted frames are broadly distributed across outlets, strengthening the generalizability of the prioritization outcome within the limits of the sampled concordance slice.

Discussion

The results of this research empirically support the idea of a multifaceted approach to prioritizing reporting-verb constructions in the context of corpus-based pedagogy of EFL academic writing, which is consistent with the general tendencies in applied linguistics, which focus on data-based target selection (Boulton & Cobb, 2017; Safaryan et al., 2025). Through frequency sensitivity analysis with register sensitivity and dispersion through outlet diversity, the findings demonstrate that there is a two-stage prioritization logic, register-sensitive frequency as a preliminary filter to identify academically distinctive candidates, and phrase-frame stability as the ultimate determinant of automatable instructional templates. This combined approach will resolve some of the major issues in EFL writing, in which students tend to have difficulties with using reporting verbs to show stance, evidentiality, and attribution (Praminatih, 2023; Liardet & Black, 2019).

The fact that register-sensitive frequency is central to the first-pass filter highlights the weaknesses of intra-register analyses, where a frequency-only approach to the Academic subcorpus would give a false sense of importance to show, even though it is not academically special (negative log2 ratio of -0.17). This is reminiscent of corpus research that has found register differences in reporting-verb distributions, with verbs prevalent in general prose potentially dominating raw frequencies, but it does not reflect genre-specific rhetorical work (Eckstein et al., 2022; Un-udom & Un-udom, 2020). For instance, *indicate* and *demonstrate* emerged as the most academically concentrated (log2 ratios of 2.84 and 2.54, respectively), consistent with their frequent use in evidential and demonstrative contexts in scholarly discourse (Yeganeh & Boghayeri, 2015; Sirijanchuen & Phoocharoensil, 2025). In contrast, *suggest* and *argue* showed moderate to strong academic skew (1.75 and 1.16), reflecting their utility in tentative and argumentative stances, which are pedagogically valuable for EFL learners navigating evaluative language (Liardet & Black, 2019; Ren, 2022).

The dispersion, which was operationalized as a proxy using unique outlets in KWIC samples, was not a sharp difference between candidates but supported the generality of extracted frames across academic sources (14-18 unique outlets per verb). This is in line with criticisms in corpus linguistics that dispersion measures should be used to supplement frequency, so that items are not artificially concentrated by source peculiarities (Gries, 2022; Tong et al., 2025). Although the constraints of the proxy, which are due to the sampled slice of the concordance, limit the inferential power, it enhances the confidence in the generality of the frames and their application in the generalized DDL tasks (Boulton & Cobb, 2017; Zare et al., 2024).

Phrase-frame stability proved the most instructionally decisive, refining frequency-based rankings by quantifying that-clause concentration (e.g., 91.43% for *suggest*, 85.71% for *argue*). This criterion highlights verbs amenable to compact templates, such as *findings suggest that...* or *it is argued that...*, which are ideal for automated noticing in CALL due to their regularity and teachability (Yan et al., 2024; Lu et al., 2018; Mizumoto, 2025). Verbs like "indicate" (51.43%) and "demonstrate" (31.43%) require construction-level constraints to mitigate polyfunctionality (e.g., procedural uses like *graphs indicate percentage...*), while *show* (40.00%) exemplifies the risks of lemma-level targeting without such refinements (Feroce et al., 2025; Ren, 2022). These trends are echoed in corpus-based research on the role of stability in phrase-frame development in EFL writing, where stability is used to track development and teach genres (Yan et al., 2024; Lu et al., 2018).

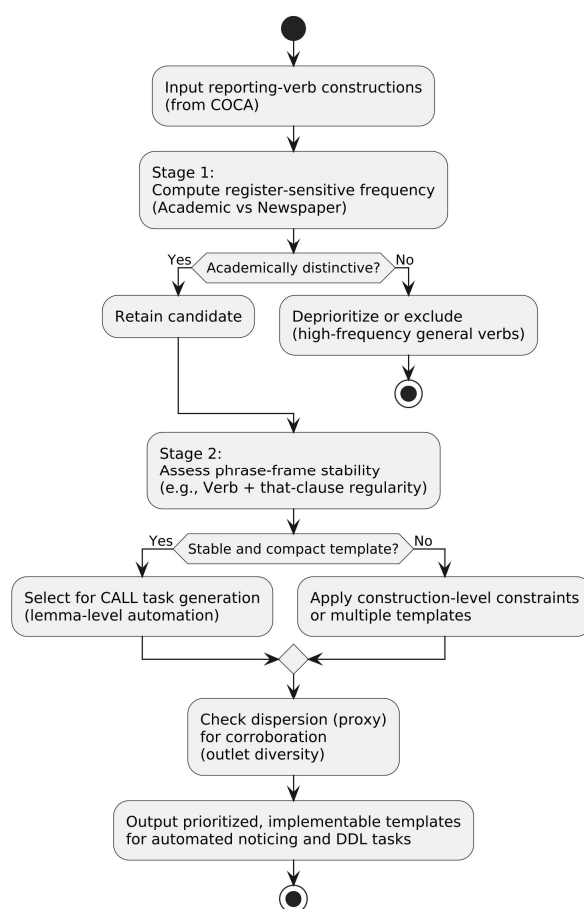


Figure 2. Two-stage prioritization logic for CALL task generation

In theory, these findings are based on the systemic functional linguistics and construction grammar, where reporting verbs are considered functional units in register-specific dimensions (Sheng & Li, 2024). Our two-stage logic (Figure 2) advances DDL and CALL integration by prioritizing *instruction-efficient* targets that balance representativeness with automatable regularity, addressing gaps in literature where criteria are applied in isolation (Boulton & Cobb, 2017; Li et al., 2025; Zare et al., 2024). This method can be used pedagogically to develop the proficiency of EFL learners in academic stance, where the interactive tools are used to provide high-yield constructions with autonomy (Mizumoto, 2025; Wang & Yan, 2025). As an example, CALL applications might use lemma-level rules to stabilize verbs such as suggest, and constrained patterns to others, which might help reduce the frequency of using generic forms and enhance lexical variety (Yeganeh & Boghayeri, 2015).

Nevertheless, limitations should be admitted. The small, year-clustered KWIC sample (35 lines per verb) used in the study is not generalizable, as is the conservativeness of the dispersion proxy, and more comprehensive measures such as Juilland's D or text-to-text range may give more nuanced differences (Gries, 2022). Additionally, focusing on five verbs and the *that-clause* frame may overlook other constructions (e.g., to-infinitive) or verbs, though selected for pedagogical relevance (Liardet & Black, 2019). The 1990-2019 period covered by the COCA, though extensive, might not reflect the current changes in the academic discourse, and it should be justified by new corpora (Sheng & Li, 2024). This may be extended in future studies by scaling to larger concordances, using more advanced NLP to detect stability automatically, or by evaluating prioritized templates in EFL interventions to quantify learning outcomes. Sensitivity metrics could be further narrowed with cross-register comparisons outside of newspapers (e.g., fiction, spoken), whereas learner corpus analyses could determine transfer in DDL tasks.

Conclusion

Overall, this paper has shown that phrase-frame stability, which is aided by register-sensitive frequency contrast, is the best criterion in identifying reporting-verb constructions that can be automated, noticing, and data-driven learning in EFL academic writing, and dispersion is used to supplementally prove that generality is valid across academic outlets. The combination of these criteria within a decision-oriented framework will allow the study to go beyond the frequency-based choice of targets and provide a principled foundation for the ability to differentiate between academically distinctive constructions and high-frequency but pedagogically misleading options.

The results contribute to corpus-based pedagogy by making the operationalization of how representativeness, regularity, and automational feasibility can be assessed together, which facilitates more specific and teaching-effective CALL task design. In practice, the suggested two-stage prioritization logic allows the creation of scalable noticing and DDL tools that predict compact and high-yield constructions and deal with polyfunctionality by constraining construction at the construction level. The empirical testing of the instructional effect of these prioritized templates in classroom and online interventions and the extension of the framework with larger concordance samples, other registers, and automated phrase-frame detection systems should be the focus of future studies, which will further bridge corpus-linguistic studies and pedagogical practice.

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