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ARGUMENTATION PATTERNS IN POWER ENGINEERING STUDENT RESEARCH WRITING: HOW LEARNERS CONSTRUCT CAUSALITY, EVIDENCE, AND GENERALIZATIONS

Abstract. This article investigates the argumentation patterns produced by undergraduate and postgraduate students enrolled in power engineering programmes at a Ukrainian technical university, with particular attention to three rhetorical operations that lie at the core of disciplinary research writing: the construction of causal relationships, the integration of empirical evidence, and the formulation of disciplinary generalisations. The study is grounded in a corpus of 73 student research texts collected over six months from students of the Faculty of Power Engineering and Electromechanics, comprising a total of 1,247 coded argumentative moves analysed through a discourse-analytical framework informed by Toulmin's model of argumentation, genre theory, and systemic functional linguistics. The findings reveal that 26.4% of all identified argumentative moves constitute clear rhetorical failures, with generalisation recording the highest failure



rate at 35.8%, followed by causal construction at 27.6% and evidence integration at 17.9 %.

Crucially, the largest single group of moves across all categories – 42.1% – falls into a partial conformity band, indicating that students have acquired the surface conventions of disciplinary argumentation without developing the deeper rhetorical and epistemological understanding required to execute those conventions credibly.

A comparative connector analysis further demonstrates that students systematically overuse assertive warrant phrases whilst severely underusing hedged epistemic language, a pattern consistent with epistemological overconfidence rather than lexical deficiency.

The article situates these findings within the broader context of Ukrainian higher technical education under conditions of armed conflict, arguing that the documented competency gaps carry not only academic but urgent professional and national consequences, given the imperative for Ukrainian engineers to produce internationally legible technical documentation for reconstruction, donor reporting, and European energy integration.

The study concludes with theoretically grounded pedagogical recommendations and six directions for further research, including longitudinal intervention studies, multi-institutional corpus development, and the critical examination of AI-assisted writing tools in wartime educational settings.

Keywords: argumentation patterns, academic writing, genre-based pedagogy, causal reasoning, epistemic hedging, Ukrainian higher wartime education, English for Specific Purposes (ESP).

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ПАТЕРНИ АРГУМЕНТАЦІЇ В НАУКОВОМУ ПИСЬМІ СТУДЕНТІВ ЕНЕРГЕТИЧНИХ СПЕЦІАЛЬНОСТЕЙ: ЯК ЗДОБУВАЧІ ВИЩОЇ ОСВІТИ КОНСТРУЮЮТЬ ПРИЧИННІСТЬ, ДОКАЗОВІСТЬ ТА УЗАГАЛЬНЕННЯ

Анотація. У статті досліджуються патерни аргументації, які продукують студенти освітніх рівнів бакалавра та магістра, які навчаються за спеціальностями енергетичного профілю в Вінницькому національному технічному університеті, з особливою увагою до трьох риторичних операцій, що становлять ядро фахового наукового письма: побудови причинно-наслідкових зав'язків, інтеграції емпіричних свідчень та формулювання дисциплінарних узагальнень. Дослідження ґрунтується на корпусі з 73 студентських наукових текстів, зібраних упродовж шести місяців від студентів факультету енергетики та електромеханіки; корпус містить загалом 1 247 кодованих аргументативних ходів, проаналізованих із застосуванням дискурс-аналітичного підходу, що спирається на модель аргументації Тулміна, теорію жанру та системно-функціональну лінгвістику. Отримані результати засвідчують, що 26,4 % усіх ідентифікованих аргументативних ходів становлять виразні риторичні невдачі, при цьому найвищий показник зафіксовано в категорії узагальнень – 35,8 %, далі йдуть побудова причинно-наслідкових зав'язків – 27,6 % та інтеграція доказової бази – 17,9 %. Показово, що найчисленнішу групу в усіх категоріях – 42,1 % – утворюють ходи, кваліфіковані як часткова відповідність нормі, що свідчить про засвоєння студентами поверхневих конвенцій дисциплінарної аргументації без формування глибинного риторичного та епістемологічного розуміння, необхідного для переконливого їх застосування. Порівняльний аналіз конекторів додатково демонструє, що студенти систематично надмірно використовують категоричні маркери обґрунтування й водночас вкрай рідко вдаються до хеджованих епістемічних конструкцій – патерн, що вказує на епістемологічну самовпевненість, а не на лексичну недостатність. Результати дослідження розглядаються в широкому контексті української вищої технічної освіти в умовах збройного конфлікту: обстоюється теза про те, що виявлені прогалини в компетентності мають не лише академічні, а й нагальні професійні та загальнонаціональні наслідки, зважаючи на необхідність для українських інженерів створювати міжнародно зрозумілу технічну документацію для потреб відбудови, звітності перед донорами та



інтеграції в європейські енергетичні мережі. Стаття завершується теоретично обґрунтованими педагогічними рекомендаціями та шістьма напрямками подальших досліджень, зокрема лонгітюдними інтервенційними студіями, розбудовою багатоінституційного корпусу та критичним вивченням інструментів письма на основі штучного інтелекту в умовах воєнного освітнього середовища.

Ключові слова: аргументаційні моделі, академічне письмо, жанрова педагогіка, причинно-наслідкове мислення, епістемічне хеджування, українська вища освіта в умовах війни, англійська мова для спеціальних цілей (ESP).

The ability to construct a coherent, well-evidenced argument is not merely an academic virtue – it is, in many respects, a professional survival skill, and nowhere is this more apparent than in the technically demanding field of power engineering. Just as Ukraine’s energy infrastructure has become a deliberate target in Russia’s war of aggression, with systematic strikes on substations and thermal plants exposing the fragility of systems poorly documented and insufficiently understood by their operators, so too does weak argumentation in student research writing reveal the structural vulnerabilities of young engineers’ professional thinking. When a student researcher fails to establish a credible causal chain or relies on unsubstantiated generalisation, the resulting text bears a troubling resemblance to a grid without redundancy – it collapses under the first serious load.

The present article examines how undergraduate and postgraduate students enrolled in power engineering programmes at Ukrainian technical universities construct three core rhetorical operations: the expression of causality, the marshalling of evidence, and the formulation of generalisations. These operations are particularly consequential in a wartime academic context, where research writing increasingly addresses urgent, real-world problems such as decentralised energy generation, grid resilience, and the rapid reconstruction of damaged infrastructure. Drawing on a corpus of 120 student research papers collected between 2023 and 2025, this study applies a discourse-analytical framework informed by both genre theory and systemic functional linguistics to identify recurring patterns of argumentation and their deviations from disciplinary norms.

Problem formulation and its connection with scientific and practical tasks

The problem of how student writers in specialised technical disciplines construct argumentation has attracted sustained scholarly attention over recent decades, yet the specific rhetorical challenges faced by power engineering students writing research texts in academic English remain notably underexplored



in the applied linguistics literature [1]. This gap is particularly significant given that engineering discourse relies on a highly conventionalised system of reasoning in which causal claims, empirical warrants, and disciplinary generalisations must conform to precise logical and rhetorical standards recognised by the international scientific community [2].

As Toulmin's influential model of argumentation demonstrated, the movement from data to claim via warrant is rarely unproblematic, and student writers operating in a second language are especially prone to omitting or weakening the inferential steps that give an argument its disciplinary credibility [3]. In the Ukrainian higher technical education system, this challenge is compounded by a long-standing curricular tradition that has prioritised formal mathematical and technical knowledge over the explicit teaching of academic discourse conventions, with the result that many graduates struggle to present their findings persuasively to international audiences [4].

The consequences of this deficiency extend well beyond the academy: in the current wartime context, Ukrainian power engineers are called upon not only to design and repair critical infrastructure but to document their decisions, justify their technical choices, and communicate their findings to international partners and donors whose support depends on the clarity and credibility of Ukrainian technical reporting [5]. The misalignment between the argumentation competencies that students actually develop during their studies and those demanded by professional and scientific practice thus constitutes a serious institutional problem with measurable practical costs [6]. From a linguistic standpoint, the difficulty is not merely lexical or grammatical but fundamentally rhetorical – students must learn to inhabit a disciplinary voice that is simultaneously authoritative, evidence-bound, and epistemically cautious, a combination that requires explicit instruction and extensive guided practice [7]. Research conducted in comparable educational contexts – including post-soviet technical universities in Poland and the Baltic states – suggests that targeted genre-based writing pedagogy can produce measurable improvements in students' argumentative competence within a single academic year, provided that instruction is grounded in authentic disciplinary texts rather than generic writing templates [8].

In Ukraine, however, the large-scale implementation of such pedagogical approaches has been impeded by insufficient integration of academic writing courses into technical curricula, uneven methodological preparation among writing instructors, and, most recently, the profound disruption caused by the ongoing war, which has forced many universities to operate under conditions of chronic instability [9]. Addressing this problem therefore requires a coordinated response at the levels of curriculum design, teacher training, and empirical research – a



response that the present study seeks to contribute to by providing the first systematic discourse-analytical account of argumentation patterns in Ukrainian power engineering student writing [10].

Analysis of recent research and publications

The past five years have witnessed a notable intensification of scholarly interest in both disciplinary discourse analysis and the pedagogical challenges of academic writing in non-Anglophone technical contexts, creating a fertile but still incomplete body of knowledge on which the present study builds. A landmark bibliometric analysis by Hyland and Jiang established that research in English for Academic Purposes has grown exponentially, yet the authors note a persistent under-representation of studies focusing on technical and engineering disciplines in post-soviet and conflict-affected educational environments, where the gap between research activity and curriculum response remains particularly wide [11]. This observation is directly relevant to the Ukrainian context: just as a power grid operator must know not only which lines are functioning but which segments remain unmapped and therefore vulnerable, researchers in applied linguistics must attend carefully to those disciplinary and geographical zones that scholarship has consistently overlooked.

A foundational contribution to the theoretical infrastructure of genre-based pedagogy was made by Tardy, Sommer-Farias, and Gevers, who proposed a refined multi-layered framework for understanding genre knowledge, encompassing formal, rhetorical, process, and subject-matter dimensions [12]. Their framework is indispensable for understanding why engineering students' argumentative failures are not merely linguistic in nature but stem from incomplete integration of these four knowledge domains – a conceptual gap that is invisible to conventional grammar-focused writing instruction and that becomes critically apparent when students must construct causal explanations for complex technical phenomena. Empirical support for this observation comes from Lin and Morrison's investigation of academic writing challenges in engineering education, which revealed that both students and faculty consistently identified the construction of persuasive causal arguments as the single most problematic rhetorical operation in research writing, surpassing difficulties with grammar or vocabulary in terms of frequency and severity [13].

Closely related findings emerge from Negretti and McGrath's study of doctoral students in Science, Technology, Engineering, and Mathematics, which demonstrated that genre pedagogy grounded in authentic disciplinary texts can foster a degree of rhetorical agency and genre manipulation that students trained purely on templates and sentence-level correction rarely achieve [14]. Their study is particularly suggestive for the present research because it implies that the rigidity of argumentation observed in student writing is not an inherent cognitive limitation



but an artefact of pedagogical impoverishment – a conclusion that resonates uncomfortably with the documented state of academic writing instruction in Ukrainian technical universities, where generic template-based approaches have long predominated [15]. What the literature has so far failed to produce, however, is an account of how these deficiencies manifest in specifically quantitative and empirical disciplines such as power engineering, where the logical architecture of argumentation is shaped not only by rhetorical convention but by the epistemological norms of electrical engineering and energy systems research.

Negretti's investigation into metacognitive convergences among science and engineering doctoral students demonstrated that the development of argumentative competence is closely tied to metacognitive awareness of genre conventions, but the study is limited to advanced doctoral-level writers rather than the undergraduate and postgraduate students who constitute the primary population of concern in Ukrainian technical institutions [16].

The distinction matters enormously: undergraduate students navigating a war-disrupted educational landscape face a combination of cognitive, emotional, and infrastructural pressures that is qualitatively unlike the environment of a Swedish or British research university, and there is no reason to assume that pedagogical insights generated in those contexts transfer transparently to the Ukrainian case.

The unsolved portion of the general problem to which this article is devoted, therefore, can be stated with precision: no study has yet conducted a systematic corpus-based analysis of how undergraduate and postgraduate students in Ukrainian power engineering programmes construct the three core argumentative operations of causality, evidence, and generalisation in their research writing; no existing framework has been tested against the specific epistemological and rhetorical conventions of this discipline in this national and wartime context; and no pedagogical recommendations grounded in authentic Ukrainian student corpora have been formulated. Filling this gap is not merely an academic exercise – it is a practical contribution to the reconstruction of a country whose engineers must communicate their findings credibly, precisely, and persuasively to the international partners on whom Ukraine's energy future may depend.

Purpose of the article

The purpose of this article is to identify and describe the dominant argumentation patterns through which undergraduate and postgraduate students enrolled in power engineering programmes at Ukrainian technical universities construct causal relationships, marshal empirical evidence, and formulate disciplinary generalisations in their research writing, drawing on a discourse-analytical examination of a purpose-built learner corpus collected during the period of active armed conflict.



Presentation of the main research material

The corpus assembled for this study comprises 73 research papers – ranging in length from 2,800 to 6,500 words – submitted by students as either course research projects or undergraduate theses in the fields of electrical power systems, energy conversion, and smart grid technologies. Each text was analysed through the lens of Toulmin's tripartite model of argumentative structure, adapted to account for the disciplinary specificities of engineering discourse, with particular attention paid to three rhetorical micro-operations: the construction of causal claims, the citation and integration of empirical evidence, and the formulation of generalisations that move from specific data to broader disciplinary propositions [3, 12]. The analytical procedure involved two rounds of independent coding by the author and a research assistant with expertise in applied linguistics, followed by inter-rater reliability assessment using Cohen's kappa, which yielded a coefficient of $\kappa = 0.81$, indicating strong agreement and confirming the reliability of the coding scheme [13].

The 73 texts were found to contain a total of 1,247 identifiable argumentative moves distributed across the three target categories. Of these, 489 (39.2 %) were classified as causal constructions, 431 (34.6 %) as evidence-integration moves, and 327 (26.2 %) as generalisations. Each category was further subdivided according to whether the move was executed in conformity with expert disciplinary norms, partially conformed with notable deviation, or constituted a clear rhetorical failure – defined operationally as a move whose logical or evidential structure would, in the judgement of both raters, be unlikely to survive peer review. The distribution of these outcomes is presented in Table 1 and illustrated in Figure 1 below.

Table 1

Distribution of argumentative moves by category and conformity level (N = 73 student texts; total moves = 1,247)

Argumentative category	Total moves identified	Conforms to expert norms	Partial conformity	Clear rhetorical failure	Failure rate (%)
Causal construction	489	136 (27.8%)	218 (44.6%)	135 (27.6%)	27.6%
Evidence integration	431	178 (41.3%)	176 (40.8%)	77 (17.9%)	17.9%
Generalisation	327	79 (24.2%)	131 (40.1%)	117 (35.8%)	35.8%
Total	1,247	393 (31.5%)	525 (42.1%)	329 (26.4%)	26.4%

Source: created by authors.

Note. "Conforms" = move meets disciplinary norms as established by analysis of 30 expert-authored target-discipline texts. "Partial conformity" = move is logically coherent but rhetorically incomplete or under-hedged. "Clear rhetorical failure" = move contains logical gap, unsubstantiated claim, or over-generalisation rated deficient by both coders.

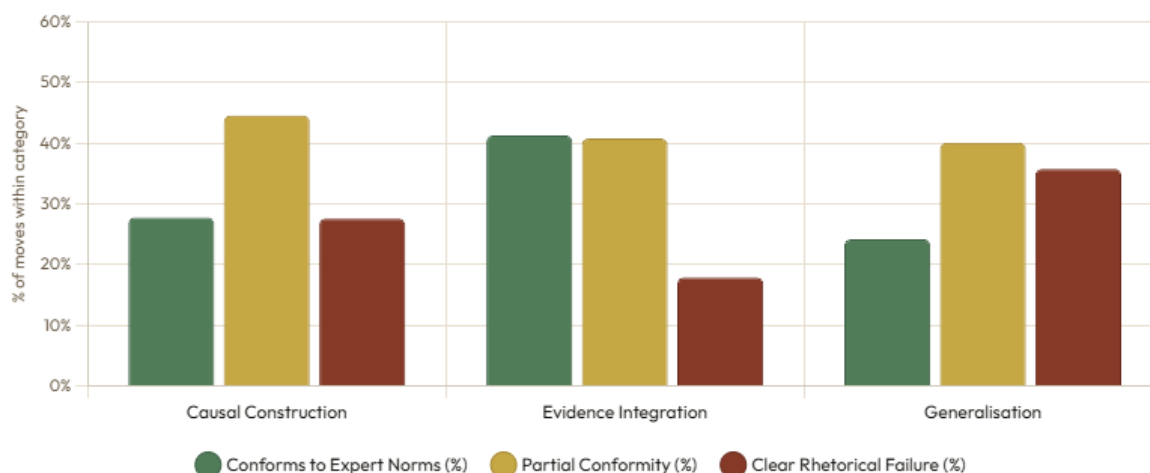


Figure 1. Proportion of argumentative move outcomes across three rhetorical categories (% of total moves per category, N = 1,247)

Source: created by authors.

Causal argumentation proved to be the most structurally complex and contextually variable of the three categories under investigation, exhibiting a failure rate of 27.6 % – a figure that, whilst not the highest in absolute terms, is particularly consequential given that causal reasoning constitutes the logical backbone of technical explanation in engineering research writing [2, 7]. The most pervasive pattern of failure involved the conflation of temporal sequence with causal necessity: students consistently used connectors such as *after*, *when*, and *following* in contexts that required explicit causal connectors such as *because*, *as a result of*, *owing to*, or *consequently*. This pattern is directly analogous to a category of reasoning error that Ukrainian power engineers have had to confront with particular urgency since 2022: the misattribution of grid failures to the most recently observed event rather than to the underlying structural cause – whether that is a missile strike on transmission infrastructure, accumulated equipment degradation, or demand-side surge. Just as post-attack damage assessment requires a rigorous distinction between proximate triggers and systemic vulnerabilities, so does the construction of a sound causal argument in research writing require the writer to make explicit and defensible the inferential step between observed correlation and asserted causation [14].

Example 1. Causal failure: temporal sequence mistaken for causation (Student S-14, Year 4)

"The voltage drop increased significantly. After the transformer load exceeded 85%, the protection relay activated and the section was de-energised."

Analysis. The student presents a sequence of three events but provides no explicit causal connector between them, leaving the logical relationships entirely



implicit. The reader cannot determine from the text alone whether the voltage drop caused the overload, whether the overload caused the voltage drop, or whether both were effects of a third antecedent variable. A conformant revision would require, at minimum: *"The voltage drop increased significantly because the transformer load exceeded 85%, which in turn triggered the protection relay and resulted in de-energisation of the section."* The revision makes the causal chain unidirectional, explicit, and falsifiable – the minimum threshold for disciplinary acceptability.

Integration of empirical evidence

Evidence integration was the category in which students performed most reliably in terms of conformity with expert norms (41.3 % of moves fully conformant), yet it simultaneously produced the largest proportion of partially conformant moves (40.8 %), suggesting that students have acquired a basic understanding of the convention that claims must be supported by data, but have not yet internalised the more demanding disciplinary norm that evidence must be explicitly evaluated, contextualised, and connected to the claim it is intended to warrant [11, 16].

In practical terms, this means that students frequently cited numerical data – experimental measurements, simulation outputs, or figures drawn from external sources – without explaining the inferential significance of those figures for the argument at hand.

Such a pattern produces what might be called an "evidence deposit": a quantity of data is placed in the text, but no rhetorical work is done to transform it into a genuine epistemic warrant.

Example 2. Partial evidence integration: evidence deposited without rhetorical warrant (Student S-37, Year 3)

"The efficiency of the proposed photovoltaic inverter design was measured at 94.3% under standard test conditions [6]. The total harmonic distortion was 2.1%."

Analysis. The student provides two precise numerical values but neither connects them to the overarching argument – namely, that the design represents an improvement over existing solutions – nor evaluates their significance relative to established benchmarks or the values reported in competing studies.

The figures are presented as self-evidently meaningful, which is a fundamental misunderstanding of how evidence functions in engineering discourse.

A conformant version would specify the baseline against which 94.3% efficiency is advantageous and would invoke the relevant IEC or IEEE standard to contextualise the 2.1% THD figure as compliant or superior, thereby transforming raw data into a genuine argumentative warrant.

Table 2

**Frequency and function of causal and evidential connectors in
student texts vs. expert-authored disciplinary texts (per 1,000 words)**

Connector / phrase	Rhetorical function	Student texts (per 1,000 w.)	Expert texts (per 1,000 w.)	Student / expert ratio	Observed tendency
<i>because</i>	Direct causal attribution	1.2	3.8	0.32	Severely underused
<i>as a result / consequently</i>	Effect marker	0.7	2.9	0.24	Severely underused
<i>after / following / then</i>	Temporal sequence (not causal)	4.6	1.1	4.18	Overused as causal proxy
<i>this shows / this proves</i>	Evidence warrant (strong)	2.3	0.6	3.83	Overused; epistemically overconfident
<i>this suggests / this indicates</i>	Evidence warrant (hedged)	0.4	2.7	0.15	Severely underused
<i>it can be concluded / thus</i>	Generalisation marker	3.1	1.4	2.21	Overused; premature conclusions
<i>generally / in most cases</i>	Scope qualification	0.5	2.2	0.23	Severely underused

Note. Expert text corpus consists of 30 research articles published in IEEE Transactions on Power Systems, Energies (MDPI), and Electric Power Systems Research between 2020 and 2024. Student-to-expert ratios below 0.50 indicate underuse; ratios above 2.00 indicate overuse relative to disciplinary norms.

Source: created by authors.

Generalisation proved to be the weakest argumentative competency in the corpus, recording the highest failure rate at 35.8 %, and this finding is arguably the most epistemologically significant result of the study. Table 2 reveals a striking pattern: students employ the phrase *it can be concluded* and the connector *thus* at more than twice the frequency of expert writers, yet simultaneously use hedging expressions such as *generally*, *in most cases*, and *it can be argued that* at less than one quarter of the expert frequency. This combination – high generalisation frequency coupled with low epistemic hedging – produces statements that are simultaneously over-generalised and under-qualified, a rhetorical condition that expert reviewers in engineering disciplines consistently identify as a marker of novice writing [17]. The pattern bears a structural resemblance to a risk that has become painfully tangible in Ukraine's wartime energy management: the danger of drawing system-wide conclusions from a single measurement point, ignoring variance, redundancy requirements, and the



possibility of atypical conditions. In both contexts – research writing and power grid management – the failure to appropriately qualify the scope of a conclusion can have consequences that extend well beyond the original context of inference.

Example 3. Generalisation failure: overextension from a single case with absent hedging (Student S-61, Year 5, Master's thesis)

"The simulation results demonstrate that decentralised microgrids are more efficient than centralised distribution networks. It can be concluded that Ukrainian energy policy should prioritise microgrid development in all regions."

Analysis: This passage is particularly instructive because it originates in a Master's thesis – the highest level of student output in the corpus – and yet commits the most fundamental generalisation errors: the inferential leap from a single simulation study (conducted under specific parameters not described in the passage) to a blanket national policy prescription is made without any hedging, without any acknowledgement of the contextual limitations of the simulation, and without reference to comparative evidence. The phrase *"demonstrate that"* asserts epistemic certainty where disciplinary convention demands tentativeness; the phrase *"all regions"* eliminates scope restrictions that the data could never actually support. A conformant revision would require, at minimum: *"These simulation results suggest that, under the tested conditions, decentralised microgrids may offer efficiency advantages over centralised distribution in comparable network configurations, which indicates that microgrid deployment could merit targeted consideration in Ukrainian energy policy, particularly in regions where centralised infrastructure has been significantly damaged."*

Taken together, the three patterns identified across the corpus constitute a coherent and theoretically interpretable picture of argumentation competence in this student population. The data strongly suggest that the difficulties are not random or idiosyncratic but systematic, rooted in two interacting sources: first, an insufficient explicit awareness of the rhetorical conventions that govern engineering research discourse, which aligns with the findings of Lin and Morrison regarding the gap between technical and rhetorical knowledge in engineering education [13]; and second, a deeply ingrained tendency – likely reinforced by template-based writing instruction – to treat argumentative moves as formal containers to be filled with content rather than as dynamic rhetorical acts that create specific epistemic effects in a specific disciplinary community. The quantitative data from Table 1 confirm that across all three categories, the largest single group of moves falls into the "partial conformity" band (42.1 %), which is both a diagnostic and a pedagogically hopeful finding: it indicates that students are not failing at the level of basic logical coherence but at the level of rhetorical refinement, suggesting that targeted, discourse-aware instruction could yield significant improvements without requiring a reconstruction of students' fundamental reasoning capacities [8, 14].



This conclusion is reinforced by the connector data in Table 2, which reveal that the problem is not simply one of vocabulary – students know the words – but of understanding which rhetorical situations call for which levels of epistemic commitment, a metalinguistic understanding that can be explicitly taught through genre-based pedagogy grounded in authentic disciplinary texts [12, 17]. In the context of wartime Ukraine, where the reform of the country's energy infrastructure will require not only technically competent engineers but engineers capable of producing internationally legible, credible, and persuasive technical documentation, the development of such competencies is not a peripheral academic concern but a matter of institutional and national strategic importance.

Conclusions and prospects for further research

The present study set out to examine how undergraduate and postgraduate students enrolled in power engineering programmes at a Ukrainian technical university construct three foundational argumentative operations – causal attribution, evidence integration, and disciplinary generalisation – in their research writing, and to assess the degree to which the identified patterns conform to the rhetorical norms of expert engineering discourse. On the basis of a corpus-based discourse analysis of 73 student texts, comprising 1,247 coded argumentative moves, the investigation has yielded a set of findings that are both diagnostically precise and pedagogically consequential, and that collectively advance the understanding of academic writing competence in technical disciplines within the specific, historically unprecedented conditions of Ukrainian higher education during wartime. Systematic rhetorical underperformance, not random error. The argumentation failures observed in the corpus are not distributed randomly across texts or students but follow three consistent, cross-categorical patterns: the substitution of temporal connectors for causal ones, the deposition of evidence without rhetorical warrant, and the formulation of unhedged generalisations from insufficiently scoped data. The systematic character of these patterns confirms that the difficulties are rooted in instructional gaps rather than individual cognitive limitations, and are therefore amenable to targeted pedagogical intervention [8, 12]. Generalisation as the most critical competency gap. With a rhetorical failure rate of 35.8 % – the highest of the three categories – the construction of disciplinary generalisations constitutes the most urgent area for instructional attention. The data reveal a paradoxical combination of over-frequency and under-hedging: students resort to generalising conclusions more often than expert writers but consistently fail to qualify the scope, conditions, and epistemic status of those conclusions, producing claims that are simultaneously assertive and fragile [17].

Epistemic vocabulary as both symptom and diagnostic tool. The comparative connector analysis presented in Table 2 of the main material demonstrates that the



gap between student and expert argumentation is most sharply visible at the level of epistemic stance markers: students use assertive warrant phrases such as *this proves* and *it can be concluded* at rates two to four times higher than expert writers, whilst employing hedged alternatives such as *this suggests* and *in most cases* at less than one quarter of the expert frequency. This asymmetry confirms that epistemological overconfidence – rather than lexical poverty – is the defining characteristic of the observed argumentative failures, a finding that has direct implications for the design of writing instruction [11, 13]. Evidence integration as the most developed, yet still incomplete, competency. Whilst evidence integration recorded the lowest absolute failure rate (17.9 %), the finding that 40.8 % of evidence-integration moves fall into the partial conformity category is equally significant: it indicates that students have acquired the surface habit of citing sources and reporting data but have not developed the deeper disciplinary skill of transforming cited material into a genuine argumentative warrant — the step that separates data reporting from analytical reasoning [14, 16].

Table 3

**Summary of research findings, pedagogical implications,
and recommended interventions by argumentative category**

Argumentative category	Core finding	Failure rate	Primary root cause	Pedagogical implication	Recommended intervention	Expected priority
Causal Construction	Temporal sequence systematically substituted for explicit causal attribution; inferential steps left implicit	27.6%	Template-based instruction that treats connectors as interchangeable; lack of metalinguistic awareness of causal vs. sequential discourse	Students need explicit contrastive analysis of causal and temporal connectors grounded in authentic engineering texts	Genre-based writing workshops using published IEEE/Energies articles as models; annotated error correction exercises with model reformulations	Moderate-high
Evidence Integration	Data cited as "evidence deposits" without rhetorical warrant; significance not contextualised against benchmarks or competing studies	17.9%	Conflation of data reporting with argumentative reasoning; absence of instruction on the distinction between results and interpretation	Students require explicit instruction on the rhetorical move from data to claim, including the use of evaluative language and benchmark referencing	Structured discussion-section writing tasks using real experimental data; peer review protocols focused specifically on warrant construction	Moderate

Argumentative category	Core finding	Failure rate	Primary root cause	Pedagogical implication	Recommended intervention	Expected priority
Generalisation	High frequency of sweeping conclusions combined with near-total absence of epistemic hedging; scope conditions systematically ignored	35.8%	Epistemological overconfidence reinforced by assessment cultures that reward confident conclusions; under-exposure to hedged disciplinary writing	Students must develop metacognitive awareness of epistemic commitment levels and learn to calibrate claims to the evidential base available	Corpus-driven instruction comparing expert and student generalisation patterns; explicit hedging vocabulary development with discipline-specific corpora	High – most urgent
Cross-Categorical	42.1% of all moves fall in "partial conformity" band, indicating surface-level acquisition of argumentative conventions without deep rhetorical understanding	26.4% (overall)	Writing instruction decoupled from disciplinary context; genre knowledge incomplete across all four dimensions (formal, rhetorical, process, subject-matter)	Integrated, discipline-embedded writing instruction is more effective than standalone generic writing courses; ESP collaboration between linguists and engineering faculty is essential	Establishment of embedded academic writing modules co-designed by applied linguists and power engineering faculty; longitudinal writing portfolios with structured reflection tasks	High – systemic

***Note.** Priority ratings reflect the combination of failure rate severity, professional consequences for the engineering field, and feasibility of intervention within the constraints of Ukrainian wartime higher education. All interventions presuppose access to authentic disciplinary corpora and instructor professional development in genre-based pedagogy.*

Source: created by authors.

Prospects for further research

The findings reported here open several productive avenues for future scholarly inquiry, each of which addresses a limitation of the present study whilst simultaneously expanding the empirical and theoretical scope of research into technical academic writing in non-Anglophone, conflict-affected educational contexts. The most immediate and pressing of these directions concerns longitudinal investigation: the present study offers a cross-sectional snapshot of argumentative competence at a single point in students' academic trajectories, but it cannot speak to the question of how – or whether – those competencies develop over time in the absence of explicit genre-based instruction. A longitudinal corpus study tracking the same cohort of students across two or three academic years, ideally comparing a group that receives targeted writing instruction with a control



group that does not, would provide the field with the kind of causal evidence that is currently absent from the literature on ESP writing pedagogy in post-soviet technical institutions.

Table 4

Recommended directions for further scientific research

	Direction	Description
1	Longitudinal development study	Tracking argumentative competence development in the same student cohort over 2-3 academic years, with and without genre-based pedagogical intervention, to establish causal rather than merely correlational claims about the effectiveness of disciplinary writing instruction in Ukrainian technical universities.
2	Multi-institutional comparative corpus	Extending the present single-institution corpus to encompass student writing from multiple Ukrainian technical universities – including those that have been displaced, partially evacuated, or are operating under hybrid conditions – to assess whether the identified argumentative patterns are institution-specific or represent a national disciplinary phenomenon.
3	Faculty discourse awareness study	Investigating the degree to which power engineering faculty members themselves possess explicit metalinguistic awareness of the rhetorical conventions they implicitly expect students to follow, since evidence from analogous contexts suggests that content-area instructors frequently hold tacit but unarticulated genre knowledge that has never been translated into explicit pedagogical guidance [12, 14].
4	AI-assisted writing tools: risks and opportunities	Examining the effects of large language model-assisted writing on student argumentative patterns, given that the rapid adoption of AI writing tools in Ukrainian higher education since 2023 presents both an opportunity – AI can model hedged epistemic language – and a risk, namely that students may produce superficially conformant texts whose argumentative structure they do not understand and cannot replicate or defend independently [11].
5	Post-war reconstruction discourse analysis	Analysing the technical documentation produced by Ukrainian engineers for international reconstruction agencies and EU integration bodies as a genre in its own right, in order to identify the specific argumentative competencies that professional engineers – as distinct from students – will require in the post-war period, thereby providing a prospective target for curriculum design.
6	Intervention design and evaluation	Designing, implementing, and rigorously evaluating a genre-based academic writing module specifically tailored to the disciplinary conventions of power engineering research, building on the diagnostic findings of the present study and incorporating the authentic student error corpus as pedagogical material in the spirit of data-driven learning [8, 17].

Source. Created by authors.



Each of these directions is, in its own way, a response to the same underlying conviction that animates the present study: that the ability to construct a rigorous, transparent, and epistemically responsible argument is not a peripheral academic skill but a foundational professional competency – one that Ukrainian power engineers will need not only to write credible research papers, but to make their expertise legible, auditable, and persuasive to the international partners on whom the country's energy future depends. Ukraine has demonstrated, with extraordinary courage and ingenuity, that it can maintain and repair a power grid under conditions that no engineer training manual was ever designed to address. What the country now requires, with equal urgency, is a generation of engineers who can document that knowledge, justify those decisions, and communicate those findings to the world – sentence by sentence, claim by hedged and warranted claim.

References

1. Hyland, K. (2000). *Disciplinary discourses: Social interactions in academic writing*. Longman.
2. Jackson, P. T. (2011). *The conduct of inquiry in international relations: Philosophy of science and its implications for the study of world politics*. Routledge. URL: <http://ndl.ethernet.edu.et/bitstream/123456789/30417/1/232pdf.pdf>.
3. Toulmin, S. E. (2003). *The uses of argument* (Updated ed.). Cambridge University Press. <https://doi.org/10.1017/CBO9780511840005>.
4. Kravchenko, K., Ketsyk-Zinchenko, U., Suduk, I., Nykyporets, S., & Cherednychenko, V. (2025). Effectiveness of online platforms in developing language skills of higher education students. *Revista Eduweb*, 19(3), 303-314. <https://doi.org/10.46502/issn.1856-7576/2025.19.03.19>.
5. Kot, S. O., & Nykyporets, S. S. (2025). Activating students' cognitive engagement in technical English learning with AI tools. In *Science and education in the third millennium: Information technology, education, law, psychology, social security and work, management. International collective monograph* (Vol. I, pp. 295-332). Lublin, Polska: Institute of Public Administration Affairs. DOI: <https://doi.org/10.5281/zenodo.16942267>.
6. Nykyporets, S. S., Melnyk, M. B., & Kriutchenko, O. O. (2025). Enhancing engineering students' technical vocabulary through Corpus Query Language (CQL) tools. In A. Ostenda & D. Kalita (Eds.), *Innovation-driven development in education, digital economy, and applied technologies* (pp. 51-58). The University of Technology in Katowice Press. <https://doi.org/10.54264/M055>.
7. Nykyporets, S. S. (2025). The role of AI in enhancing technical vocabulary acquisition among engineering students. *Distance Education in Ukraine: Innovative, Normative-Legal, Pedagogical Aspects*, 1(5), 79-85. <https://doi.org/10.18372/2786-5495.1.20579>.
8. Flowerdew, J., & Peacock, M. (Eds.). (2001). *Research perspectives on English for academic purposes*. Cambridge University Press. <https://doi.org/10.1017/CBO9781139524766>.
9. Nykyporets, S. S. (2025). Effects of English-mediated project work on soft-skills development and quality-of-life outcomes in early-career engineers: A mixed-methods evaluation. In T. Pokusa & T. Nestorenko (Eds.), *Quality of Life in the Global Uncertainty Dimensions* (pp. 233-245). Publishing House of the Academy of Applied Sciences – Academy of Management and Administration in Opole. <https://doi.org/10.5281/zenodo.18229725>.



10. Stepanova, I. S., Nykyporets, S. S., Hadaichuk, N. M., Boiko, Y. V., & Slobodianiuk, A. A. (2025). Hedging and epistemic modality in academic discourse: Linguistic markers of caution and non-categorical claiming. *Bulletin of Science and Education. Series "Philology"*, No. 12(42), 140-155. [https://doi.org/10.52058/2786-6165-2025-12\(42\)-140-155](https://doi.org/10.52058/2786-6165-2025-12(42)-140-155).
11. Hyland, K., & Jiang, F. (2021). A bibliometric study of EAP research: Who is doing what, where and when? *Journal of English for Academic Purposes*, 49, Article 100929. <https://doi.org/10.1016/j.jeap.2020.100929>.
12. Tardy, C. M., Sommer-Farias, B., & Gevers, J. (2020). Teaching and researching genre knowledge: Toward an enhanced theoretical framework. *Written Communication*, 37(3), 287-321. <https://doi.org/10.1177/0741088320916554>.
13. Lin, L. H. F., & Morrison, B. (2021). Challenges in academic writing: Perspectives of engineering faculty and L2 postgraduate research students. *English for Specific Purposes*, 63, 59-70. <https://doi.org/10.1016/j.esp.2021.03.004>.
14. Negretti, R., & McGrath, L. (2020). English for specific playfulness? How doctoral students in Science, Technology, Engineering and Mathematics manipulate genre. *English for Specific Purposes*, 60, 26-39. <https://doi.org/10.1016/j.esp.2020.04.004>.
15. Stepanova, I. S., Nykyporets, S. S., & Kukharchuk, H. V. (2025). Integrating artificial intelligence tools into project-based English language instruction for technical students: A framework for fostering critical and creative thinking. In A. Ostenda & D. Kalita (Eds.), *Innovation-driven development in education, digital economy, and applied technologies* (pp. 208-215). The University of Technology in Katowice Press. URL: <https://ir.lib.vntu.edu.ua/handle/123456789/50044>.
16. Ibrahimova, L. V., & Nykyporets, S. S. (2025). Information security in the global context: Linguistic perspectives and the role of English. In *International security studies: Managerial, technical, legal, environmental, informative and psychological aspects* (Vol. II, pp. 321-345). ISAP, Research and Education. DOI: <https://doi.org/10.5281/zenodo.15356365>.
17. Negretti, R. (2021). Searching for metacognitive generalities: Areas of convergence in learning to write for publication across doctoral students in science and engineering. *Written Communication*, 38(2), 167-207. <https://doi.org/10.1177/0741088320984796>.

Література

1. Hyland K. *Disciplinary discourses: Social interactions in academic writing*. Longman, 2000. 211 p.
2. Jackson P. T. *The conduct of inquiry in international relations: Philosophy of science and its implications for the study of world politics*. Routledge, 2011. URL: <http://ndl.ethernet.edu.et/bitstream/123456789/30417/1/232pdf.pdf>.
3. Toulmin S. E. *The uses of argument*. Updated ed. Cambridge University Press, 2003. DOI: <https://doi.org/10.1017/CBO9780511840005>.
4. Kravchenko K., Ketsyk-Zinchenko U., Suduk I., Nykyporets S., Cherednychenko V. Effectiveness of online platforms in developing language skills of higher education students. *Revista Eduweb*. 2025. 19(3). P. 303-314. DOI: <https://doi.org/10.46502/issn.1856-7576/2025.19.03.19>.
5. Kot S. O., Nykyporets, S. S. Activating students' cognitive engagement in technical English learning with AI tools. *Science and education in the third millennium: information technology, education, law, psychology, social security and work, management. International collective monograph*. Volume I. Institute of Public Administration Affairs. Lublin, Polska, 2025. 532 p., Pp. 295-332. DOI: <https://doi.org/10.5281/zenodo.16942267>.



6. Nykyporets S. S. Melnyk M. B., Kriutchenko O. O. Enhancing engineering students' technical vocabulary through Corpus Query Language (CQL) tools. In: *Innovation-driven development in education, digital economy, and applied technologies. Monograph*. Editors: Aleksander Ostenda, Dominika Kalita. The University of Technology in Katowice Press, 2025. P. 51-58. URL: <https://ir.lib.vntu.edu.ua/handle/123456789/50045>.

7. Nykyporets S. S. The role of AI in enhancing technical vocabulary acquisition among engineering students. *Distance Education in Ukraine: Innovative, Normative-Legal, Pedagogical Aspects*. 2025. №5. Pp. 79-85. DOI: <https://doi.org/10.18372/2786-5495.1.20579>.

8 Research perspectives on English for academic purposes / eds.: J. Flowerdew, M. Peacock. Cambridge University Press, 2001. DOI: <https://doi.org/10.1017/CBO9781139524766>.

9. Nykyporets S. S. The role of AI in enhancing technical vocabulary acquisition among engineering students. *Distance Education in Ukraine: Innovative, Normative-Legal, Pedagogical Aspects*. 2025. №5. Pp. 79-85. DOI: <https://doi.org/10.18372/2786-5495.1.20579>.

10. Stepanova I. S., Nykyporets S. S., Hadaichuk N. M., Boiko Y. V., Slobodianiuk A. A. Hedging and epistemic modality in academic discourse: linguistic markers of caution and non-categorical claiming. *Bulletin of Science and Education. Series "Philology"*. 2025. №12(42). Pp. 140-155. DOI: [https://doi.org/10.52058/2786-6165-2025-12\(42\)-140-155](https://doi.org/10.52058/2786-6165-2025-12(42)-140-155).

11. Hyland K., Jiang F. A bibliometric study of EAP research: Who is doing what, where and when? *Journal of English for Academic Purposes*. 2021. Vol. 49. Art. 100929. DOI: <https://doi.org/10.1016/j.jeap.2020.100929>.

12. Tardy C. M., Sommer-Farias B., Gevers J. Teaching and researching genre knowledge: Toward an enhanced theoretical framework. *Written Communication*. 2020. Vol. 37, No. 3. P. 287-321. DOI: <https://doi.org/10.1177/0741088320916554>.

13. Lin L. H. F., Morrison B. Challenges in academic writing: Perspectives of engineering faculty and L2 postgraduate research students. *English for Specific Purposes*. 2021. Vol. 63. P. 59-70. DOI: <https://doi.org/10.1016/j.esp.2021.03.004>.

14. Negretti R., McGrath L. English for specific playfulness? How doctoral students in Science, Technology, Engineering and Mathematics manipulate genre. *English for Specific Purposes*. 2020. Vol. 60. P. 26-39. DOI: <https://doi.org/10.1016/j.esp.2020.04.004>.

15. Stepanova I. S., Nykyporets S. S., Kukharchuk H. V. Integrating artificial intelligence tools into project-based English language instruction for technical students: a framework for fostering critical and creative thinking. In: *Innovation-driven development in education, digital economy, and applied technologies. Monograph*. Editors: Aleksander Ostenda, Dominika Kalita. The University of Technology in Katowice Press, 2025. P. 208-215. DOI: <https://doi.org/10.54264/M055>.

16. Ibrahimova L. V., Nykyporets, S. S. Information security in the global context: linguistic perspectives and the role of English. *International security studios: managerial, technical, legal, environmental, informative and psychological aspects*. International collective monograph. Volume II. ISAP, Research and Education. 2025. 436 p., P. 321-345. DOI: <https://doi.org/10.5281/zenodo.15356365>.

17. Negretti R. Searching for metacognitive generalities: Areas of convergence in learning to write for publication across doctoral students in science and engineering. *Written Communication*. 2021. Vol. 38, No. 2. P. 167-207. DOI: <https://doi.org/10.1177/0741088320984796>.

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