

HOW DO BIOLOGISTS LEARN ENGLISH?

Abdumuratova Lobar Iskandar qizi

Student of Samarkand State Pedagogical Institute

Ro`ziyeva Sarvinoz Mahmud qizi

Student of Samarkand State Pedagogical Institute

Annotation: *This article examines how biologists learn English as a professional and disciplinary language, focusing on the interaction between general proficiency development and biology specific discourse practices. The study aims to identify effective learning pathways that align language acquisition with authentic research activities such as reading articles, writing reports, and presenting data. A qualitative design was applied, combining discourse analysis of biology texts, semi structured interviews with biology students and early career researchers, and a small corpus based review of recurrent lexical and syntactic patterns in laboratory and publication genres. The methodological novelty lies in integrating English for Specific Purposes principles with genre based pedagogy and evidence from biology communication routines. The findings propose a staged model linking vocabulary growth, genre awareness, and communicative competence, offering practical implications for curriculum design in biology programs.*

Keywords: *English for biology; disciplinary discourse; academic literacy; genre based learning; vocabulary acquisition; research communication; reading to write.*

Аннотация: *В статье рассматривается, как биологи осваивают английский язык как профессиональный и дисциплинарный ресурс, с акцентом на связь общего развития языковой компетенции и специфики биологического дискурса. Цель исследования состоит в выявлении эффективных траекторий обучения, которые согласуют усвоение языка с реальными научными практиками, включая чтение статей, написание отчетов и представление данных. Использован качественный дизайн, объединяющий дискурс анализ биологических текстов, полуструктурированные интервью со студентами биологических направлений и молодыми исследователями, а также обзор малого корпуса типичных лексических и синтаксических паттернов в лабораторных и публикационных жанрах. Научная новизна заключается в интеграции подходов English for Specific Purposes, жанровой педагогики и эмпирических данных о коммуникативных рутинах в биологии. Результатом является поэтапная модель, связывающая рост словаря, жанровую осведомленность и коммуникативную компетентность.*

Ключевые слова: *английский для биологии; дисциплинарный дискурс; академическая грамотность; жанровое обучение; усвоение словаря; научная коммуникация; чтение для письма.*

Introduction: English functions as the dominant medium for the circulation of biological knowledge, shaping how evidence is reported, reviewed, and reused across laboratories and countries. For biologists, learning English is therefore less a matter of achieving general conversational fluency than of acquiring the capacity to participate in a set of conventionalized communicative activities, including reading method dense articles, interpreting figure captions, writing concise results, and negotiating meaning in peer feedback. Research on English for Specific Purposes has long argued that language learning becomes more efficient when it is organized around the communicative needs of a target community, rather than around decontextualized grammar progression [1]. However, the practical implementation of this principle remains uneven in biology programs where English may be taught as an ancillary subject with limited connection to disciplinary practice. In such contexts, learners often develop fragmented skills: they may memorize terminology without mastering argument structure, or they may read abstracts without being able to extract methodological constraints, limitations, and claims. The gap is reinforced by the rhetorical specificity of scientific writing, which employs hedging, cautious generalization, and standardized moves that differ from everyday English and even from other academic fields [2].

Recent scholarship in disciplinary literacy highlights that scientific language is not merely a vocabulary set but a system of meaning making linked to epistemic values such as replication, quantification, and transparent reporting [3]. For biologists, this means that learning English is inseparable from learning how to write what counts as acceptable evidence statements, how to relate results to hypotheses, and how to phrase uncertainty and significance. At the same time, many biology students and early career researchers increasingly engage with English through digital channels, including preprint servers, video lectures, and international collaboration platforms. While these channels expand exposure, they can also intensify the pressure to produce polished English outputs, leading to anxiety, overreliance on templates, or excessive focus on error avoidance at the expense of clarity. Against this background, the present study addresses the problem of how biologists learn English in ways that strengthen disciplinary participation, not just formal correctness. The article aims to develop an empirically grounded model of learning pathways that integrates vocabulary development, genre awareness, and communicative competence in key biology genres. The objectives are to identify recurrent language demands across laboratory and publication contexts, to document learners' perceived barriers and successful strategies, and to synthesize these insights into a staged framework with curricular and self learning implications. The scientific novelty lies in connecting micro level discourse patterns with learners' reported practices, thereby operationalizing disciplinary literacy for implementable pedagogy. The practical value concerns biology departments seeking to embed English development into research training and to support students preparing for international publication and mobility.

Materials and Methods. The study employed a qualitative, multi source design intended to capture both the textual properties of biology communication and the learning behaviors of biologists at early stages of professionalization. First, discourse analysis was conducted on a purposive sample of biology texts representing typical communicative events: laboratory record excerpts, method descriptions, results paragraphs, figure captions, and short discussion segments. Selection criteria emphasized diversity of subfields while retaining shared genre constraints, thereby allowing identification of stable rhetorical moves and recurring language forms. Second, semi structured interviews were held with biology undergraduate seniors, master's students, and early career researchers who were actively reading and writing in English. Interview prompts elicited accounts of learning histories, strategies for reading articles, approaches to vocabulary, experiences with writing and feedback, and perceived differences between English classes and laboratory communication. Third, a small corpus informed review was used to triangulate findings by examining frequent lexical bundles, collocations, and syntactic patterns common in biology writing, especially those related to quantification, methodological precision, and hedging. The methodological rationale follows genre based pedagogy, which treats genres as teachable social actions and emphasizes explicit attention to structure, stance, and lexico grammatical realizations [4]. To enhance credibility, the analysis iteratively compared interview themes with textual observations, seeking convergence on the language demands most central to biology participation. Ethical considerations were addressed through anonymization of participants and removal of identifiable project details, while focusing analysis on language practices rather than personal evaluation.

Results. Analysis of the text sample indicated that biology English is organized around a limited set of high frequency communicative functions that recur across genres, even when topics change. In method and laboratory record segments, the dominant functions were procedural sequencing, specification of materials and conditions, and control of variability. These functions were consistently realized through passive constructions, nominalizations, and dense prepositional phrases that compress technical detail into compact units. Learners reported that such density makes comprehension difficult even when individual terms are known, because critical constraints are encoded in modifiers rather than in main verbs. In results and figure caption segments, the dominant functions were description of observable patterns, quantification, comparison across conditions, and signaling of statistical support. The language showed recurrent patterns that combine measurement expressions, comparative structures, and concise linking devices that guide the reader from observation to interpretation without fully entering argumentative discussion.

Interview data revealed that biologists typically learn English through a layered exposure pathway rather than through linear syllabus completion. Participants described an initial phase dominated by terminology acquisition, often driven by textbook reading and bilingual glossaries. Yet many noted that terminology alone did

not transfer to writing because they lacked control of typical verb choices, phrase frames for describing trends, and standard ways of reporting uncertainty. A second phase was characterized by intensive reading of articles in which learners began to recognize predictable section structures and rhetorical moves, such as the transition from broad problem framing to specific research questions in introductions, or the shift from key findings to limitations in discussions. This phase often produced a partial genre awareness: learners could anticipate what a section should contain, but they still struggled to paraphrase and synthesize without copying. A third phase emerged when learners engaged in authentic writing tasks, commonly triggered by thesis preparation, conference abstracts, or manuscript drafting. At this stage, feedback from supervisors and peer reviewers became a primary learning driver, and participants reported rapid improvement in cohesion devices, stance markers, and the ability to make claims proportionate to evidence.

Across sources, three categories of persistent difficulty were identified. The first was lexical but not purely terminological: learners struggled with high utility academic words and phraseological units that carry argumentative and procedural meaning, such as verbs for controlling variables, indicating correlation, or delimiting scope. The second was syntactic and informational: participants found it hard to manage long noun phrases, embedded clauses, and compression strategies typical of scientific prose, leading either to overly short sentences that fragmented logic or to overly long sentences with unclear reference. The third was rhetorical and pragmatic: learners reported uncertainty about how direct they could be in claims, how to hedge appropriately, and how to align statements with evidence and statistical outcomes. Notably, many participants used English primarily as an input language for reading, while producing output in their first language until a publication requirement forced a sudden switch. Those who developed stable progress tended to integrate small, regular output practices, including maintaining laboratory notes in English, summarizing articles in structured formats, and reusing validated phrase frames while adapting them to new data.

The synthesis of results led to a staged model of how biologists learn English effectively. Stage one centers on foundational comprehension, in which terminology learning is integrated with sentence level parsing skills for methods and results. Stage two emphasizes genre recognition, enabling learners to map communicative goals onto section structures and to predict the type of language expected. Stage three focuses on controlled production through scaffolds such as phrase banks, model texts, and feedback cycles. Stage four involves autonomous participation, marked by strategic reading for writing, confident revision, and the ability to negotiate meaning with international peers in collaborative settings. The model is not strictly linear, but it indicates the typical dependencies observed: without genre recognition, vocabulary remains inert; without controlled production, reading does not convert to writing competence; without feedback cycles, errors and nonstandard rhetorical moves persist.

Discussion. The findings support the view that biologists learn English most effectively when learning activities mirror the epistemic practices of the field, thereby operationalizing disciplinary literacy as a practical instructional principle. The layered exposure pathway aligns with the ESP argument that needs analysis and genre orientation should guide curriculum design [1]. It also resonates with research describing scientific writing as a set of socially recognized rhetorical moves, where success depends on mastering stance, evidentiality, and the sequencing of claims [2]. Importantly, the present results refine these perspectives by showing how specific textual difficulties, such as information compression in method descriptions and cautious claim making in discussions, are experienced by learners as barriers that cannot be resolved through terminology study alone. In this sense, the study extends genre based pedagogy by emphasizing the transition mechanisms between stages, especially the role of small scale but regular output practices that allow learners to test language choices under low stakes conditions.

Comparison with prior work suggests that biology presents an especially strong coupling between language and quantification. Learners' difficulties with comparatives, statistical reporting phrases, and hedging reflect the field's commitment to calibrated claims and replicable description. This supports the argument that academic literacy in sciences depends on learning how language encodes evidence relations and uncertainty, not only on correctness [3]. The model also highlights feedback as a central learning engine in stage three and four, which is consistent with writing research emphasizing revision cycles and audience awareness. However, in many biology departments, feedback on English is provided informally and inconsistently, often focusing on surface errors rather than on rhetorical adequacy. The staged model implies that supervisors and language instructors can coordinate: language support can target predictable genre problems, while supervisors can comment on clarity and claim strength rather than attempting to correct every grammatical detail. In this respect, corpus informed phraseology can serve as a shared reference, reducing the subjective nature of stylistic advice and enabling learners to adopt standard patterns without rote copying [5].

The practical implications are twofold. For curriculum design, English instruction for biologists should be embedded into research training, with tasks that mirror laboratory and publication genres. Reading activities should be linked to writing outputs, for example by requiring structured summaries that include purpose, method, results, and limitations, thus training learners to extract rhetorical functions. For self directed learning, the model supports a strategy of combining targeted vocabulary work with phrase frame acquisition and iterative rewriting of one's own texts, rather than relying on passive exposure. This approach is consistent with recommendations in applied linguistics to prioritize high frequency academic language and discipline specific collocations, supported by authentic examples [6].

The study has limitations. The qualitative design prioritizes depth over broad representativeness, and the small corpus informed review does not claim

comprehensive coverage of all biology subfields. Interview data reflect self reported practices, which may underrepresent unrecognized learning influences such as implicit imitation of supervisors' writing. Future research could test the staged model quantitatively by measuring gains in section specific writing quality after targeted interventions, and could expand to multilingual contexts where biologists publish in English while teaching and documenting in other languages. Another direction is to investigate how AI assisted writing tools affect learning trajectories, distinguishing between tools that scaffold learning and those that encourage dependence without competence growth.

Conclusion. Biologists learn English most successfully when they treat it as a disciplinary practice tightly connected to reading, writing, and presenting scientific evidence, rather than as a separate general language subject. The study identified recurrent language demands in biology genres, including procedural precision in methods, quantitative description in results, and calibrated stance in discussion. Learners' effective pathways were characterized by layered exposure that progresses from terminology plus parsing skills to genre awareness, then to scaffolded production with feedback, and finally to autonomous participation in international communication. The proposed staged model clarifies dependencies among vocabulary expansion, genre competence, and communicative performance, offering a practical basis for integrating English development into biology curricula and research training.

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