Shell Noun Usage in Science Undergraduate Academic Writing: Insights from Mukuba University, Zambia

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

This study examined the use of shell nouns in the academic writing of science undergraduate students at Mukuba University, Zambia, focusing on their frequency, patterns, and functions across multiple disciplines. The topic was chosen due to the critical role of shell nouns in enhancing coherence, formality, and objectivity in academic writing, which are essential skills for scientific communication. Grounded in Halliday and Hasan's theory of cohesion, the research aimed to (1) investigate the frequency of shell noun use across disciplines, (2) identify patterns in their usage across academic years, and (3) evaluate their functional contributions to coherence, formalization, and objectivity in student writing. A qualitative approach was employed, involving the analysis of written samples from disciplines including Biology, Chemistry, Public Health, Nutrition Science,

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Agricultural Science, Computer Science, Environmental and Climate Change, and Biomedical Science. The data set consisted of lab reports, research papers, and essays collected from first-year to final-year students. The data analysis involved frequency counts and thematic coding to identify trends and patterns in shell noun usage. The findings revealed notable disciplinary variations, with Chemistry and Biomedical Science demonstrating higher frequencies of shell noun use. Shell nouns played a vital role in maintaining textual coherence, formalizing tone, and enhancing objectivity in the students' writing. More advanced usage was evident among final-year students, suggesting a developmental progression in academic writing skills. However, challenges such as inconsistent use and difficulty applying shell nouns effectively in complex writing tasks were also identified. The study highlighted the importance of targeted pedagogical interventions, recommending the inclusion of explicit instruction on shell noun usage in writing curricula. Suggestions for future research included expanding the sample size, incorporating a broader range of genres, and adopting a longitudinal approach. By examining linguistic features in academic writing within a sub-Saharan African context, this research provided valuable insights for educators seeking to enhance writing instruction and support student success.

1. INTRODUCTION

Academic writing is a crucial skill for university students, particularly those engaged in scientific disciplines, as it enables them to communicate complex ideas and research findings effectively. One of the key features of academic writing that facilitates the expression of abstract concepts and maintains clarity and cohesion is the use of shell nouns**.** These nominalizations (e.g., *factor, process*, *aspect*, *issue*) help condense complex thoughts into concise terms, facilitating both coherence and cohesion in academic texts (Hyland, 2004). Shell nouns are essential tools in academic writing because they allow the writer to refer to a broad concept in a generalized form, making writing more succinct and organized (Biber, et al., 1999). Despite the importance of these tools, students often face challenges in applying them effectively within their own writing.

In Zambia, English serves as the official language and the medium of instruction in educational settings (Zambia National Commission for UNESCO, 2019). However, the multilingual nature of the country means that many students speak different local languages, and English is often a second or third language for many learners (Kunda, 2018). Consequently, students in Zambia, particularly those in higher education institutions, face significant challenges when it comes to academic writing in English, which differs significantly from conversational or informal English in both structure and vocabulary. Although Zambia has made progress in expanding access to education at all levels, there is still a concern about the quality of academic writing among university students, particularly in subjects that require extensive written communication, such as science, engineering, and business (Arshad, 2019). Many students enter higher education institutions with inadequate skills in academic writing, which impedes their ability to perform well in written assessments, research papers, and other academic tasks that require critical thinking and formal expression (Mweemba & Mwiinga, 2016).

Mukuba University, a public institution located in the heart of Zambia's Copperbelt, serves as a key educational establishment in the region, offering programs in various fields, including science, technology, engineering, business, and education. Many of the students at Mukuba University come from diverse backgrounds, with varying levels of proficiency in English. As the medium of instruction, English poses a significant challenge for many students, especially those from rural areas where English is not widely spoken. In this context, the Communication Skills course plays a pivotal role in equipping students with essential academic writing skills that are crucial for their academic success. Despite the course's focus on writing proficiency, students often face challenges in applying the theoretical knowledge gained from the course to their actual writing tasks. This is especially evident when it comes to the use of shell nouns, a key tool for achieving cohesion and coherence in academic texts. Students are introduced to shell nouns early in the course, but their ability to incorporate these tools effectively into their own writing remains limited. This gap in application is a significant concern for educators at Mukuba

University, as it directly affects the quality of students' academic work.

The problem addressed by this study is the gap between theoretical instruction on shell nouns and their practical application in academic writing. Although the Communication Skills course introduces students to the use of shell nouns to improve writing coherence and cohesion, students often struggle to apply these linguistic tools effectively in their academic work. This issue is particularly evident in the writing of first-year students who, despite their understanding of the theory behind shell nouns, encounter difficulties when tasked with incorporating them into their essays and assignments. The lack of effective application of shell nouns undermines the overall clarity and structure of students' writing, which is especially problematic in fields like science, where clarity and precision are paramount. This gap in knowledge application is an issue not only at Mukuba University but also at other higher education institutions in Zambia and similar African countries where English is not the first language. Students who are unable to effectively utilize academic writing tools such as shell nouns may struggle with articulating their ideas clearly, leading to lower academic performance and hindered academic success (Flowerdew, 2000). Therefore, it is crucial to explore the reasons behind this difficulty and propose strategies to enhance students' ability to apply shell nouns in their writing. Therefore, this study aims to explore the use of shell nouns in the academic writing of science undergraduates at Mukuba University, with specific objectives as follows:

1. To investigate how the use of shell nouns varies across different academic disciplines.
2. To analyze how the use of shell nouns changes over the course of students' academic years.
3. To examine the roles and purposes of shell nouns in academic writing.

2. LITERATURE REVIEW

2.1 Broad Discussion

Shell nouns, also known as abstract nouns that encapsulate complex meanings or concepts within a single lexical item, are essential in academic writing as they serve to organize discourse, maintain coherence, and link various parts of an argument. These nouns function as connectors within texts, aiding in the presentation and evaluation of ideas, which enhances clarity and helps readers navigate through complex academic content. Schmid (2000) laid the foundation by illustrating the dual syntactic and semantic functions of shell nouns. Since Schmid's pioneering work, the scope of research has expanded, revealing the nuanced roles shell nouns play in structuring academic arguments, guiding readers through texts, and facilitating knowledge organization across disciplines. Recent research has continued to investigate the importance of these elements, examining how they vary in different academic genres, their use by both native and non-native writers, and the cultural factors influencing their use.

2.2 Existing Studies

Recent studies in shell nouns have enriched the understanding of their disciplinary, cultural, and linguistic applications, addressing their varied usage across academic contexts, and further exploring the pedagogical implications of these findings. This section synthesizes key studies from various domains, focusing on disciplinary patterns, contrasts between native and non-native writers, cross-linguistic and cultural influences, and the role of pedagogical frameworks in improving proficiency in shell-noun usage.

2.2.1 Disciplinary and genre-specific patterns

Research has increasingly highlighted the discipline-specific usage of shell nouns, with studies indicating that the type and frequency of shell-noun use are shaped by the rhetorical conventions of specific fields. For example, Benítez-Castro (2021) identified a range of shell nouns used in disciplines such as Sociology, Business, and Engineering. In Sociology, nouns such as "problem," "issue," and "perspective" were frequently employed to critique theoretical ideas, while Engineering texts preferred more concrete nouns like "method," "process," and "technique," emphasizing precision and description. These findings align with Liu and Deng's (2017) study, which indicated that scientific writing, particularly in professional journals, uses more abstract nouns such as "fact," "concept," and "theory," while popular science texts tend to feature more accessible language. In contrast, academic texts in the humanities often rely on abstract shell nouns to engage in critical reflection, showcasing the varying rhetorical needs across disciplines.

Recent work by Wang and Hu (2023) confirmed these findings, emphasizing the genre-specific function of shell nouns in different academic contexts, and urging further exploration in genres such as literature reviews and case studies to understand shell-noun distribution fully.

Furthermore, recent interdisciplinary studies (Li & Wang, 2022) reveal that the increasing intersectionality of disciplines—such as in interdisciplinary research journals—has led to more hybrid forms of shell-noun usage, combining abstract and concrete elements to satisfy diverse rhetorical needs. This calls for a more holistic approach in future studies that account for the complex and evolving nature of disciplinary boundaries.

2.2.2 Native vs. non-native writers

The comparison of native (L1) and non-native (L2) writers has been a significant focus in shell-noun research, particularly in the realm of academic writing. Early studies by Aktas and Cortes (2008) and Sing (2013) observed that L1 writers tend to use shell nouns with greater lexical variety and sophistication, demonstrating a deeper understanding of academic discourse. L2 writers, by contrast, were found to rely more on generic and formulaic terms like "thing" or "matter," often lacking the nuanced use of more abstract nouns. Hyland and Tse (2005) argued that this difference can be attributed to the limited exposure to academic writing conventions and lexical resources of L2 writers. Recent work by Shafiee et al. (2022) challenges this view, noting that highly proficient L2 writers can demonstrate shell-noun proficiency that is comparable to their native-speaking counterparts when given access to appropriate training and resources.

Other studies (Fang & Dong, 2021) emphasize the impact of educational systems and cultural factors on the acquisition of shell-noun proficiency among L2 learners. These studies found that L2 writers, especially in non-English dominant countries, often demonstrate difficulties in mastering the use of shell nouns in academic writing, primarily due to a lack of targeted writing instruction and exposure to academic discourse. This indicates that the gap in shell-noun usage between L1 and L2 writers is not only a linguistic issue but also a matter of educational practice and cultural adaptation. To address this, Hyland (2022) advocates for explicit pedagogical strategies that focus on developing L2 learners' lexical resources through genre-based instruction

and guided exposure to academic texts, reinforcing the connection between language proficiency and academic writing skills.

2.2.3 Cultural and cross-linguistic variations

Cultural and linguistic influences play a crucial role in shaping shell-noun usage, with significant cross-linguistic variations in how these nouns are deployed in academic writing. Schanding and Pae (2018) observed that Japanese writers tend to use more general and vague terms like "thing" and "matter," reflecting the cultural emphasis on indirectness and politeness. Tahara (2017) extended this by noting that Japanese L2 learners often mimic their L1 discourse patterns, employing shell nouns predominantly for anaphoric referencing in both their first and second languages. These findings align with those of Li and Wang (2022), who examined Chinese L2 learners and found that they frequently use shell nouns in a similar fashion, influenced by the linguistic and cultural norms of their native language.

Recent research by Xie (2023) explored how the use of shell nouns in Chinese and English academic writing differs. They found that Chinese scholars tend to use a narrower range of shell nouns compared to their English-speaking counterparts, largely due to differences in syntactic structures and rhetorical conventions between the two languages. This highlights the importance of considering cultural and linguistic factors when studying shell-noun usage, as these factors shape the way academic discourse is constructed across languages. Furthermore, research into multilingual contexts (Ananiadou & McNamara, 2022) has shown that multilingual academic environments influence shell-noun usage in both written and spoken forms. Scholars in multilingual contexts tend to draw on a mix of lexical resources from their L1 and L2, leading to more varied and innovative uses of shell nouns. This reflects the need for a deeper understanding of cross-linguistic and cross-cultural influences, with an emphasis on studying how multilingual writers combine linguistic elements from multiple languages to construct coherent academic texts.

2.2.4 Pedagogical insights

The growing interest in shell-nouns has prompted a shift toward incorporating these linguistic features into academic writing instruction, particularly for non-native speakers.

Hyland and Tse (2005) emphasized the importance of genre-based instruction, which teaches students to recognize the rhetorical functions of shell nouns and their role in structuring academic discourse. Recent studies, such as those by Lin (2023), have shown that shell-noun instruction can improve the writing quality of L2 learners by enhancing their ability to organize ideas coherently and structure arguments more effectively.

Liang (2024) conducted an in-depth examination of shell-noun usage in both Chinese and English academic writing, finding that while Chinese scholars showed consistent use of certain shell nouns in both languages, English-native writers displayed more flexibility in employing a broader range of terms. Liang's findings reinforce the idea that pedagogical interventions should focus on helping students diversify their lexical choices and understand the pragmatic functions of shell nouns in academic writing. Lin et al. (2023) work on Czech L2 learners further underscores the importance of targeted instruction, revealing that Czech learners, although proficient in academic English, still struggled with shell-noun usage compared to native speakers. This highlights the need for pedagogical frameworks that focus on the syntactic and semantic versatility of shell nouns.

Moreover, research by Leon et al. (2018) suggests that pedagogical approaches incorporating corpus-based methods can enhance students' understanding of shell-noun usage. By analyzing large corpora of academic texts, learners can observe authentic examples of shell-noun application, allowing them to better understand their contextual functions. Recent work by Lin (2023) has built on these findings, showing that corpus-informed teaching can significantly improve students' ability to use shell nouns appropriately and efficiently in their writing.

2.3 Synthesis of New Studies

Recent studies have continued to explore the challenges and opportunities related to shell-noun usage in academic writing. Lin (2023) found that although L2 learners in Czech used fewer shell nouns compared to native speakers, their performance improved significantly when instructed on how to incorporate them into their writing. Similarly, Liang's (2024) comparative study of shell-noun use in Chinese and English academic writing further emphasized the cultural

and linguistic distinctions in shell-noun patterns, suggesting that L2 writers' challenges could be mitigated through tailored instruction that bridges the gap between different writing traditions. These studies confirm the critical role that shell nouns play in structuring academic discourse and suggest that pedagogical interventions, including corpus-based teaching and genre-specific instruction, can help L2 writers enhance their use of shell nouns. Furthermore, these studies highlight the importance of examining the evolving role of shell nouns in the context of interdisciplinary research, multilingual writing, and cross-cultural academic environments. As academic writing continues to grow more globalized, research on shell nouns will remain integral in understanding how language can be used to organize and convey knowledge in complex and coherent ways.

2.4 Theoretical Frameworks

Research on shell nouns is grounded in several theoretical frameworks that offer distinct analytical lenses. These frameworks provide structured methodologies for understanding how shell nouns function across various contexts, genres, and cultural settings, highlighting their cohesive, referential, and rhetorical dimensions.

2.4.1 Schmid's (2000) shell-nounhood framework

Schmid's Shell-Nounhood Framework serves as a foundational model for analyzing shell nouns, categorizing them based on their cohesive and referential functions. Shell nouns are identified as abstract nouns that depend on co-text for their full interpretation, bridging semantic gaps and creating textual cohesion. This framework has been instrumental in advancing the understanding of shell nouns' linguistic roles. For instance, Aktas and Cortes (2008) adopt Schmid's model to analyze how shell nouns contribute to the overall coherence of academic texts, identifying frequently occurring patterns such as "fact," "issue," and "problem." These nouns are shown to serve as cohesive devices, linking ideas and guiding readers through complex arguments.

Despite its utility, Schmid's framework primarily focuses on the functional classification of shell nouns and their referential roles, leaving the rhetorical and reader-centered effects of their usage relatively underexplored. Questions such as how shell nouns influence reader

comprehension, engagement, or the persuasive strength of a text remain unanswered. This limitation suggests the need for further research integrating Schmid's framework with rhetorical and discourse analysis to capture a broader spectrum of shell-noun functions.

2.4.2 Genre theory

Genre theory provides a contextual lens for understanding shell nouns, emphasizing the relationship between linguistic features and the communicative purposes of specific genres. According to Swales (1990), genres are socially situated and purpose-driven, which influences the choice and function of linguistic elements, including shell nouns. Liu and Deng (2017) employ genre theory to investigate shell-noun usage in scientific writing, revealing how these nouns facilitate textual cohesion and fulfill evaluative functions specific to the genre. For example, shell nouns such as "evidence," "method," and "observation" are frequently used in scientific texts to organize information, express judgments, and maintain objectivity.

While genre theory highlights the adaptability of shell nouns to different communicative demands, its application remains limited to a narrow range of disciplines, predominantly the sciences and social sciences. Further research could extend this framework to genres such as reflective essays, technical reports, or multimodal texts, offering insights into how shell nouns support diverse rhetorical goals. Additionally, the theory's potential to analyze cross-disciplinary variations in shell-noun usage remains underutilized, presenting opportunities for comparative studies.

2.4.3 Contrastive rhetoric

Contrastive rhetoric examines the influence of cultural and linguistic backgrounds on writing practices, providing valuable insights into shell-noun preferences among L2 writers. Rooted in Kaplan's (1966) work on rhetorical patterns, this framework posits that rhetorical conventions are shaped by cultural norms, which can transfer to L2 writing. Schanding and Pae (2018) utilize contrastive rhetoric to analyze shell-noun usage among Korean L2 English writers, demonstrating that preferences for certain shell nouns, such as "idea" or "point," are influenced by rhetorical strategies prevalent in their native language. The study underscores the role of cultural and linguistic transfer in shaping shell-noun usage, particularly in academic contexts.

While contrastive rhetoric effectively highlights cultural variability, its application to shell nouns has been relatively limited. Broader studies incorporating diverse linguistic backgrounds, such as African, South Asian, or Latin American L2 writers, could enrich the understanding of how cultural norms influence shell-noun selection and usage. Furthermore, integrating contrastive rhetoric with cognitive and sociolinguistic perspectives could deepen insights into how learners navigate the interplay between their L1 conventions and the demands of L2 academic writing.

Each of these frameworks—Schmid's Shell-Nounhood Framework, genre theory, and contrastive rhetoric—offers unique insights into shell-noun usage. However, they often operate in isolation, limiting their explanatory power. Integrating these frameworks could yield a more comprehensive understanding of shell nouns by addressing their functional, contextual, and cultural dimensions simultaneously. For instance, a combined approach could explore how cultural influences (contrastive rhetoric) shape shell-noun preferences within specific genres (genre theory) and how these preferences fulfill cohesive functions (Schmid's framework). This integrated perspective would provide a richer and more nuanced account of shell-noun usage across diverse linguistic and academic landscapes.

2.5 Research Gaps

Despite advancements, several critical gaps in shell-noun research remain, limiting its breadth and applicability. These gaps highlight the need for more diverse and interdisciplinary approaches to study shell nouns in academic and broader communicative contexts.

2.5.1 Corpus limitations

Most studies rely on limited datasets, such as the British Academic Written English (BAWE) corpus (Benítez-Castro, 2021) or small collections of argumentative essays (Tahara, 2017). While these corpora offer valuable insights into shell-noun usage, they fail to account for the linguistic and cultural diversity of global academic writing. This narrow focus reduces the generalizability of findings, particularly to multilingual or non-native English-speaking contexts. Expanding research to include writers from underrepresented regions, such as Asia or Africa, as well as multilingual academic environments, could provide a more

comprehensive understanding of shell-noun usage across diverse linguistic and cultural backgrounds.

2.5.2 Overemphasis on quantitative analysis

Research on shell nouns has predominantly focused on quantitative metrics, such as frequency counts and pattern identification, often overlooking the qualitative dimensions of their usage. For instance, Aktas and Cortes (2008) document recurring shell-noun patterns but do not investigate how these patterns influence rhetorical impact or reader comprehension. This narrow focus limits the understanding of the nuanced roles shell nouns play in shaping text cohesion and argument strength. Incorporating qualitative methods, such as discourse analysis or reader-response studies, could yield richer insights into how shell nouns contribute to the perceived clarity, persuasiveness, and coherence of academic texts.

2.5.3 Cognitive and pedagogical dimensions

The cognitive processes underlying shell-noun selection remain poorly understood, creating a significant gap in current research. For example, while Tahara (2017) identifies common errors in L2 learners' shell-noun usage, the study does not explore the mental strategies or challenges learners face when selecting appropriate shell nouns. Employing neurocognitive methods or longitudinal research designs could help uncover how writers internalize and apply shell-noun functions over time. Additionally, the effectiveness of targeted pedagogical interventions for improving shell-noun usage remains underexplored. Evaluating instructional strategies such as scaffolded learning, explicit teaching of shell-noun functions, or feedback-driven practice could bridge the gap between theoretical research and classroom application.

2.5.4 Multilingual and multimodal contexts

The increasing prominence of digital and multimodal academic discourse introduces new questions about the adaptability of shell nouns. For instance, how do shell nouns function in digital formats such as blogs, social media posts, or conference presentations compared to traditional essays? Current research has largely neglected these emerging contexts, limiting the applicability of findings to contemporary academic and professional communication. Investigating shell-noun usage in these multimodal and digital genres could provide valuable insights into their evolving functions and relevance in dynamic communicative landscapes. Addressing these gaps could significantly advance the understanding of shell nouns, particularly in their cognitive, rhetorical, and pedagogical dimensions. Incorporating diverse methodologies, theoretical perspectives, and underrepresented contexts will enhance the applicability and relevance of findings for both academic research and practical instruction.

3. METHODOLOGY

This study investigated the use of shell nouns in science undergraduate students' writing at Mukuba University, Zambia, focusing on their frequency, functions, and rhetorical roles in academic texts. A qualitative case study design was chosen to provide an in-depth examination of how shell nouns are employed in academic writing within the specific institutional and disciplinary context of a Zambian university. The research aimed to offer insights into how these linguistic elements contribute to the coherence, objectivity, and argumentation in science genres, specifically within the context of undergraduate students' writing. Written texts served as the sole data source for this study, ensuring a focused analysis of shell-noun usage in academic writing across different scientific disciplines.

3.1 Research Design

A qualitative case study approach was adopted to explore the use of shell nouns in science undergraduate students' writing. This design allowed for an in-depth examination of how students use shell nouns across different genres of academic writing, such as essays, research papers, and lab reports, within the context of their studies at the University. A case study was an appropriate methodology because it provided a detailed and context-specific understanding of how shell nouns are employed in academic discourse. The study was aimed at identifying patterns in the usage of shell nouns, their syntactic and functional roles, and their contribution to the overall coherence and argumentation in students' academic texts.

The study focused on science undergraduates as a specific group within the University, allowing for an exploration of how the linguistic demands of science writing influence students' use of shell nouns. Given that science disciplines are known for their emphasis on objectivity, clarity, and

logical progression of ideas, examining the use of shell nouns in this context was particularly pertinent. Shell nouns, as nominalized forms used to represent processes, actions, and concepts, are prevalent in academic writing because they facilitate cohesion and maintain the formal tone often required in scientific writing.

3.2 Participants and Sampling Methods

The participants in this study were science undergraduate students at Mukuba University, drawn from a range of academic years and programs of study within the sciences. The sampling technique used for this study was stratified purposive sampling, which ensured that participants were selected from different years of study and academic disciplines, providing a comprehensive representation of the student population. This technique was specifically chosen to allow the researcher to examine potential variations in the use of shell nouns across academic stages (first-year, second-year, and third-year students) and scientific disciplines such as biology, chemistry, environmental science, and physics. Stratified purposive sampling is particularly useful in case study research because it allows for the targeted selection of participants based on specific criteria relevant to the research objectives, in this case, the academic year and program of study.

A total of 25 participants were selected for this study, with 6-8 participants chosen from each academic year to ensure a balance across the different stages of undergraduate study. These students were enrolled in the various science programs offered at Mukuba University, including programs in biological sciences, physical sciences, and environmental studies. The stratification ensured that students from different years of study and disciplines were included, offering a diverse range of data for analysis. This approach allowed the study to explore how students at different stages of their academic careers utilize shell nouns in writing tasks and whether their usage varies according to their academic progression and disciplinary focus.

The stratified purposive sampling technique enabled the researcher to capture the evolving use of shell nouns as students advance through their academic programs. For example, first-year students may use shell nouns less frequently or with less precision than third-year students, reflecting their developing writing skills and understanding of academic writing conventions.

Additionally, this approach allowed for the investigation of how disciplinary differences may influence shell-noun usage, as students in more technical or research-oriented programs may have different writing practices compared to those in more general science programs. The sample was also purposively chosen to include a range of students who were actively engaged in writing tasks within their science courses, ensuring that the written samples collected were directly relevant to the research focus on shell nouns in academic writing.

3.3 Data Collection

The primary data collection method for this study was the analysis of written samples from participants. These written samples included a variety of academic texts such as essays, research papers, lab reports, and other course-related assignments that required students to use formal academic language. The decision to focus on written texts was made to provide a controlled analysis of students' written work, as these assignments reflect the students' ability to apply academic conventions, including the use of shell nouns, in formal written contexts. Written texts also allow for the identification of linguistic elements in a stable form, making them well-suited for qualitative analysis.

Data collection was conducted through the submission of written assignments that were either assigned during the semester or chosen by the participants themselves, provided these assignments included a significant amount of academic writing where shell nouns might typically appear. Informed consent was obtained from all participants prior to the collection of written texts. Participants were assured that their assignments would be anonymized to ensure confidentiality and that their participation would not affect their academic standing. The written samples were then collected from each participant and analyzed for the presence of shell nouns.

Each written sample was carefully examined for the occurrence of shell nouns, which were defined as nominalized expressions that often represent processes, actions, or abstract concepts. For example, phrases such as "the development of," "the examination of," and "the analysis of" are commonly used in academic writing to encapsulate ideas or processes in a more formal and objective manner. The researcher cataloged each instance of shell

nouns and noted their syntactic structures, functions, and rhetorical roles within the texts. The focus of this analysis was on how shell nouns contributed to the coherence and objectivity of the students' academic writing, and how they helped structure arguments or present concepts within the genre-specific constraints of science writing.

3.4 Data Analysis

The data analysis followed a thematic approach. The thematic analysis approach allowed the researcher to identify and categorize shell nouns based on their functional roles. The shell nouns were categorized into four major themes:

3.4.1 Nominalization

Shell nouns served to replace verbs or adjectives, simplifying complex processes into generalized concepts. For example:

1. "The **process** demonstrated the effectiveness of the treatment."
2. "The **hypothesis** suggests a correlation between the variables."

In these instances, the original actions or ideas (e.g., "demonstrates," "suggests") are nominalized into abstract nouns like "process" and "hypothesis," maintaining the impersonal tone that is typical of academic writing. This allows the writer to focus on the broader concepts without delving into the specifics of the actions, which is often desirable in academic discourse.

3.4.2 Summarization and presentation of findings

Shell nouns were particularly useful in summarizing research outcomes. By using terms such as *"results"* and *"findings,"* students were able to abstract their conclusions without over-explaining specific details. For instance:

1. "The **results** indicated a significant difference between the two groups."
2. "The **findings** support the initial assumptions."

The above usages contributed to brevity and clarity in the text, allowing students to focus on the key outcomes without redundant elaboration.

3.4.3 Argument structuring

Shell nouns also played a crucial role in structuring arguments and positioning research within a broader theoretical context. For example:

1. "The **framework** used in this study was developed based on previous research."
2. "This **model** provides a comprehensive approach to understanding the phenomena."

Terms like *"framework"* and *"model"* helped students present their arguments within a coherent structure, providing a clear link between their research and existing theories or models. These shell nouns facilitated the logical flow of ideas, ensuring that the research was situated within a conceptual framework that the reader could easily follow.

3.4.4 Cohesion

Shell nouns were also integral in maintaining cohesion across various sections of academic texts. By linking ideas and maintaining a consistent terminology, they ensured that the text flowed logically. For instance:

1. "The **evidence** gathered from the experiments supports the theory."
2. "This **study** extends the research conducted by Smith et al."

These examples illustrate how shell nouns contribute to text cohesion by creating smooth transitions between different sections of the writing, linking new ideas to established concepts, and ensuring that the argument remains focused and coherent throughout the text.

3.5 Ethical Considerations

Ethical considerations were paramount throughout the research process. The study adhered to the principles of voluntary participation, confidentiality, and informed consent. Prior to participation, all students were informed of the purpose of the study, their rights to confidentiality, and their right to withdraw from the study at any time without penalty. Written consent was obtained from each participant, ensuring that they were fully aware of how their data would be used. To maintain confidentiality, the students' names were anonymized, and pseudonyms were used for all written samples. The data were stored securely, with access restricted to the researcher alone.

4. RESULT

This section presents the findings of the study on the use of shell nouns in science undergraduate students' writing. The findings are categorized into thematic areas based on the research questions, including disciplinary variations, academic year differences, the functions of shell nouns, and their impact on students' writing. Written samples from lab reports, research papers, and essays were analyzed to reveal patterns of shell-noun use. These findings are presented in a detailed and comprehensive manner to reflect the depth of the students' writing practices.

4.1 Disciplinary Variations in the Usage of Shell Nouns

One of the key findings of the study was the variation in the frequency and types of shell nouns used across disciplines. The analysis revealed that students from different disciplines exhibited distinct patterns of shell noun use, which reflect the writing conventions and expectations of their respective fields. The thematic matrix below summarizes the themes.

The thematic matrix highlights the varying use of shell nouns across disciplines. Students in Biomedical Science, Chemistry, and Biology displayed the highest frequency of shell noun usage (15–20 instances per 1000 words), with terms like "the study," "the results," and "the hypothesis" commonly appearing in lab reports and research papers. This pattern highlights the

emphasis on formal and abstract language in these fields to represent findings and methods. In contrast, Agricultural Science and Public Health students used fewer shell nouns (5–10 instances per 1000 words), opting for descriptive writing styles that bridge theory and real-world applications. Computer Science students exhibited the lowest frequency (3–8 instances per 1000 words), as their writing often favoured technical specificity over abstract generalizations, exemplified by terms like "the system" and "the algorithm." These findings suggest that the function and frequency of shell nouns are shaped by the distinct rhetorical and communicative needs of each discipline.

4.2 Shell Noun Usage across Academic Years

Another significant finding was the difference in shell noun usage across the years of study from first year to fourth year. The thematic matrix 2 gives the details of the findings.

The matrix 2 presents a clear progression of shell noun usage across the academic years of undergraduate students, highlighting a shift from limited to advanced use as students gain proficiency in academic writing. In the first year, students exhibited limited use of shell nouns, primarily relying on descriptive writing styles with phrases like "the experiment" and "the results," reflecting their early-stage academic writing skills.

Table 1. Thematic Matrix 1: Use of shell nouns across disciplines

Theme	Category	Disciplines	Example Shell Nouns	Instances o usage (per 1000 words)	Key Observations
Formal and Abstract Language	High Use of Shell Nouns	Biomedical Science, Chemistry, Biology	*the study, the results, the hypothesis*	15–20	Emphasized in lab reports and research papers for abstract representation of findings.
Descriptive Writing	Moderate to Low Use of Shell Nouns	Agricultural Science, Public Health	*the analysis, the outcome*	5–10	Focused on connecting theory to practical applications.
Technical Precision	Low Use of Shell Nouns	Computer Science	*the system, the algorithm*	3–8	Technical writing prioritizes specific terminology over abstract nouns.

Table 2. Thematic Matrix 2: Shell noun usage across academic years

Theme	Category	Academic Year	Example Shell Nouns	Instances of Usage (per 1000 words)	Key Observations
Writing Style Progression	Limited Use of Shell Nouns	First-Year Students	the experiment, the results	7–12	Students relied on descriptive writing with limited use of shell nouns, reflecting early-stage academic writing skills.
	Moderate Use of Shell Nouns	Second-Year Students	the analysis, the outcome	12–17	Shell noun usage improved as students adopted more structured and analytical writing styles.
	Proficient Use of Shell Nouns	Third-Year Students	the study, the findings, the results	17–22	Students effectively used shell nouns to enhance abstraction and coherence, showcasing a better understanding of academic writing conventions.
	Advanced Use of Shell Nouns	Fourth-Year Students	the hypothesis, the conclusion	20–25	Students demonstrated mastery of shell nouns, integrating them seamlessly to convey complex ideas and arguments.

In the second year, there was a moderate increase in the use of shell nouns, such as "the analysis" and "the outcome," as students began to adopt more structured and analytical writing approaches. By the third year, students showed more proficiency, using shell nouns like "the study," "the findings," and "the results," to enhance abstraction and coherence in their writing, indicating a deeper understanding of academic conventions. Finally, in the fourth year, students demonstrated advanced use of shell nouns, with examples such as "the hypothesis" and "the conclusion," integrating them seamlessly into their writing to effectively convey complex ideas and arguments. This progression underscores the development of academic writing skills, with an increasing ability to employ impersonal and abstract language as students advance through their studies.

4.3 Functions of Shell Nouns in Writing

The study identified several key functions of shell nouns in students' writing. These functions were consistent across disciplines and genres, demonstrating the integral role shell nouns play in scientific writing, as presented in Matrix 3 below.

Thematicmatrix 3 highlights the essential functions of shell nouns across various academic disciplines and their instances of usage in student writing. The abstraction of findings function was the most prominent in experimental and natural sciences like Biology and Chemistry, where summarizing research outcomes are critical to achieving precision and formality. In contrast, the textual cohesion function was observed disciplines such as Public Health and Nutrition Science, helping link research components such as methodology, results, and discussions effectively. Meanwhile, the framing arguments function was prevalent in Environmental and Agricultural Sciences, where shell nouns are pivotal in presenting evidence-backed claims systematically. These observations emphasize the role of shell nouns in enhancing clarity, coherence, and academic rigor in students' writing, with variations driven by the communicative demands of different fields.

Table 3. Thematic Matrix 3: Functions of Shell Noun in Writing

Function	Example	Discipline	Instances of use (per 1000 words)	Observation
Abstraction of Findings	"The study revealed a significant correlation between variables."	Biology, Chemistry, Biomedical Science	15 – 20	Widely used to summarize findings, especially in research-heavy disciplines requiring formal tone.
Textual Cohesion	"The method used in this research was adapted from previous studies."	Public Health, Nutrition Science	10 – 15	Commonly employed to ensure logical flow and connections between sections of research reports.
Framing Arguments	"The evidence supports the hypothesis that higher temperatures affect soil quality."	Environmental Science, Agricultural Science	10 – 15	Frequently used to frame evidence-based arguments in discussions or conclusions within these fields.

4.4 Disciplinary and Genre Differences

There were also differences in shell noun usage across writing genres within the same discipline. For instance, lab reports in Chemistry and Biology showed the highest frequency of shell nouns due to the standardized nature of reporting experimental findings. In contrast, essays in Agricultural Science and Public Health contained fewer shell nouns, with students often adopting a more narrative approach to present arguments and discuss implications. Thematic matrix 4 provides the details of the findings.

Thematic matrix (4) shows that Biology and Biomedical Science and Chemistry had the highest use of shell nouns in lab reports and research papers due to the need for clear and structured reporting. In Agricultural Science and Public Health, shell noun usage was lower in essays and research papers, as students focused more on narrative and argumentation. Computer Sciencehad the lowest frequency, using fewer shell nouns to focus on technical details. Environmental Science showed moderate use of shell nouns for generalization and argument framing in lab reports and

Table 4. Thematic Matrix 4: Genre-Specific Shell Noun Usage

Discipline	Genre	Shell Noun Frequency (per 1000 words)	Function	Observation
Biology & Biomedical Science	Lab reports, Research papers	35 – 45	Abstraction, cohesion	Lab reports and research papers used many shell nouns for clear and objective reporting of findings.
Chemistry	Lab reports, Research papers	30 – 40	Abstraction, cohesion	Chemistry students also used shell nouns frequently in lab reports and research papers for structured reporting.
Agricultural Science	Essays, Research papers	15 – 25	Description, argument framing	Essays and research papers had fewer shell nouns as students focused more on narrative and

Discipline	Genre	Shell Noun Frequency (per 1000 words)	Function	Observation
				argumentation.
Public Health	Lab reports, Essays	20 – 30	Evidence, argument framing	Public Health students used shell nouns for presenting evidence and framing arguments in lab reports and essays.
Computer Science	Research papers	10 – 15	Technical abstraction	Computer Science research papers used fewer shell nouns, focusing more on technical details.
Environmental Science	Lab reports, Research papers	20 – 30	Generalization, framing	Environmental Science students used shell nouns for generalizing and framing arguments in lab reports and research papers.

research papers. This highlights how the genre and focus of the writing influence the use of shell nouns.

5. DISCUSSION

The findings from this study on the use of shell nouns in science undergraduate students' writing provide valuable insights into how students in various disciplines employ language to meet the expectations of academic writing. The use of shell nouns is closely tied to the conventions of specific disciplines and genres, with differences observed across academic years as well. These differences can be attributed to students' growing familiarity with academic writing and the genre-specific requirements of scientific communication.

5.1 Disciplinary Variations in Shell Noun Usage

The study observed that students in Biomedical Science, Chemistry, and Biology used the highest frequencies of shell nouns, while students in Agricultural Science, Public Health, and Computer Science demonstrated lower frequencies. The higher frequency of shell nouns in the former disciplines can be attributed to the nature of the writing in these fields. For example, disciplines like Biomedical Science and Chemistry often involve detailed reporting of experimental results and procedures, which require a formal, objective tone. The frequent use of shell nouns such as "the study," "the hypothesis," and "the results" allows students to

focus on the research itself rather than the researcher, thereby meeting the expectations of objectivity that are central to scientific communication (Hyland, 2005, Swales, 1990). This is consistent with the existing literature, which underscores the role of abstraction and objectivity in scientific writing (Benítez-Castro & Thompson, 2015).

In contrast, disciplines like Agricultural Science and Public Health tend to focus on the practical application of research and often allow for a less formal, more narrative approach to writing (Channel, 2000). As a result, the use of shell nouns is less frequent in these fields. This variation in shell noun usage across disciplines aligns with findings from studies that highlight genre- specific language use in academic writing (Biber, 2006).

5.2 Shell Noun Usage Across Academic Years

The study found that students in all cohorts—first, second, third, and fourth years—used shell nouns with varying frequencies. Fourth-year students used shell nouns the most, while first-year students used them the least. This difference in usage can be explained by the students' growing familiarity with academic writing conventions over time. As students progress through their studies, they are exposed to more formal writing tasks that require abstract, impersonal language—functions that shell nouns serve effectively (Swales, 1990, Hyland, 2005).

In the first year, students typically focus on developing basic writing skills, such as sentence structure, paragraph organization, and foundational grammar. As part of the curriculum, they are introduced to communication skills, which include writing in a formal academic style. This early exposure helps set the groundwork for more advanced academic writing tasks in later years. During this time, students often rely on more narrative or descriptive language, as they are still learning to write in the impersonal style demanded by academic writing (Engin, 2014).

By the second year, students begin to engage with more structured academic writing. They start producing assignments that require a higher level of abstraction, although they may still struggle with the more formal conventions of academic writing. As students approach their third year, they are expected to produce more complex academic work, including lab reports, research papers, and extended essays. These tasks demand greater formality and abstraction, which are facilitated by the use of shell nouns. By the third year, students are more comfortable with the conventions of academic writing and can use shell nouns to present their findings objectively, in line with academic expectations.

Fourth-year students, having developed a stronger grasp of academic writing conventions, use shell nouns most frequently. At this stage, students are required to complete advanced research projects and dissertations, which demand formal, impersonal language. Shell nouns such as "the study," "the research," and "the results" help these students present their work in an objective, neutral tone, distancing themselves from the research and focusing more on the content of their findings. This progression in shell noun usage is consistent with research on writing development, which suggests that students' academic writing skills improve over time, particularly in their ability to use abstract, cohesive, and objective language. Studies by Atkas et al. (2008) and Thonus (2002) highlight how academic language competence develops gradually, with later-year students demonstrating a more sophisticated use of academic conventions.

Thus, the findings show a clear trend of increased use of shell nouns as students advance in their academic careers. The shift from basic writing techniques in the first year to more formal, abstract, and impersonal writing in the third and fourth years highlights the progressive nature of academic writing development. This is further supported by the curriculum design, which emphasizes the importance of formal writing tasks and communication skills at each stage of the students' academic journey.

5.3 Functions of Shell Nouns in Writing

The study identified several key functions of shell nouns in academic writing, particularly within the context of scientific disciplines. One of the most important functions of shell nouns is their ability to facilitate the abstraction of research findings. In academic writing, particularly in the sciences, it is essential to present research in a manner that is impersonal and objective. This helps to shift the focus from the researcher to the findings themselves. By using shell nouns like "the study," "the research," and "the results," students are able to depersonalize their writing, avoiding the inclusion of personal pronouns or subjective commentary that could introduce bias or a sense of individual ownership. This is especially important in scientific writing, where the emphasis is on presenting findings in a neutral, fact-based manner Coffin, 2004). By employing shell nouns, writers create a sense of distance between themselves and the content, allowing readers to focus on the results rather than the individual conducting the research.

Another significant function of shell nouns is their role in maintaining textual cohesion across different sections of academic writing. Shell nouns serve as referential devices that link ideas and arguments together, ensuring the logical flow between various sections such as the introduction, methods, results, and discussion. Hyland (2005) highlights the importance of cohesion in academic writing, noting that successful academic texts depend on the smooth connection between ideas and concepts. Shell nouns help establish these links by referencing previously discussed concepts or introducing new ones in a way that allows the text to flow logically. For example, the use of terms like "the findings" or "the analysis" helps to maintain continuity, guiding the reader through different parts of the paper without losing track of the central argument. This cohesion is especially crucial in research papers, where the organization of ideas is vital to making a compelling and coherent argument.

Shell nouns also play a crucial role in framing arguments and presenting research findings in a structured and logical manner. In scientific writing, the ability to present research findings without appearing overly subjective or emotional is essential. Shell nouns such as "the theory," "the argument," or "the hypothesis" enable students to introduce concepts and findings in a way that maintains an objective tone. This aligns with the expectations of scientific discourse, where the focus is on presenting research results in a neutral and structured way (Swales, 1990). By framing arguments with these abstract nouns, writers ensure that their work is perceived as analytical and unbiased. This function helps to guide the reader through the research process, making the argument more persuasive and easier to follow, without relying on personal opinions or emotive language.

These functions are consistent with existing literature on the role of shell nouns in academic writing. Research by Hyland (2005) and Thonus (2002) underscores the importance of shell nouns in creating formal, objective, and cohesive texts. Shell nouns help to abstractly reference previous research and findings, allowing writers to avoid overwhelming readers with excessive details while maintaining clarity and precision. By performing these functions, shell nouns contribute to the overall effectiveness of academic writing, ensuring that research is communicated in a way that aligns with the conventions and expectations of the academic community.

5.4 Disciplinary and Genre Differences

The study also revealed differences in shell noun usage across writing genres within the same discipline. For instance, students in Biology and Chemistry used more shell nouns in labreports and research papers due to the standardized nature of reporting experimental findings. In contrast, essays in Agricultural Science and Public Health showed fewer shell nouns, as students often adopted a more narrative approach to present their arguments. This variation can be explained by the different writing conventions of each genre. Lab reports and research papers typically require a more formal and objective tone, which shell nouns help achieve, whereas essays tend to allow more descriptive or argumentative styles (Gosden, 1992). This finding is consistent with research on genre analysis in academic writing, which emphasizes the importance of understanding genre-specific language conventions (Biber, 2006, Swales, 1990). In scientific genres such as lab reports and research papers, the emphasis on objectivity and formality explains the higher frequency of shell nouns, while more descriptive genres, like essays, are characterized by a less formal style.

6. CONCLUSION

This study aimed to examine the use of shell nouns in academic writing among undergraduate science students, focusing on how their application varies across disciplines, academic years, and writing genres. The key findings highlight the critical role of shell nouns in enhancing the formality, clarity, and cohesion of students' writing, while also reflecting the conventions and expectations of scientific academic writing. Furthermore, the study revealed that the use of shell nouns is developmentally progressive, with fourth-year students demonstrating a more sophisticated and accurate use compared to first-year students. These results are consistent with the literature on academic writing, which underscores the importance of shell nouns in structuring complex scientific ideas and maintaining an objective, impersonal tone. The findings suggest that shell nouns not only facilitate communication but also serve as a bridge between novice and expert academic writers. Consequently, there is a clear need for continued instruction and practice in using shell nouns effectively, particularly for students in fields that prioritize formal academic language and coherence.

This study contributes to the understanding of how undergraduate science students utilize shell nouns in their writing, offering insights into the developmental aspects of their writing skills. The research also suggests that targeted instructional strategies focusing on the use of shell nouns could help improve the overall quality of academic writing. Future research could expand on this work by investigating the role of other academic language features, such as modality and hedging, in students' writing, as well as exploring how genre-specific writing practices influence shell noun usage.

CONSENT

As per international standards or university standards, Participants' written consent has been collected and preserved by the author(s).

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc., have been used during the writing and editing of this manuscript. This explanation includes the names, versions, models, sources of the generative AI technologies, and all input prompts provided to the AI tools.

Details of the AI usage are given below:

1. Grammarly (Version: Premium; Model: Language Processing AI) - Used for grammar checking, sentence structure improvement, and ensuring the manuscript adheres to academic writing conventions.
2. QuillBot AI (Version: Pro; Model: Paraphrasing and Summarizing AI) - Used for paraphrasing and refining text to enhance clarity, coherence, and fluency while preserving the original meaning.
3. Concessus (Version: Professional; Model: Academic Writing Assistance AI) - Used for improving logical flow and argumentation structure, ensuring that the manuscript aligns with academic standards for argument coherence.

These tools were utilized to enhance the quality of the manuscript while maintaining academic integrity and originality. Their usage contributed to the clarity, grammatical accuracy, and logical cohesion of the study without substituting the essential intellectual contribution of the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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