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Survey on Common Spelling Errors in Chemistry Students' English Reports

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Abstrak

Penelitian ini mengkaji kesalahan ejaan yang banyak ditemukan dalam laporan praktikum mahasiswa kimia, faktor-faktor yang memengaruhinya, serta tingkat akurasi ejaan dalam penulisan ilmiah. Desain penelitian menggunakan pendekatan kuantitatif dengan metode deskriptif naratif, melibatkan 58 mahasiswa kimia dari berbagai universitas di Indonesia. Data dikumpulkan menggunakan kuesioner skala Likert berjumlah 35 item dan dianalisis menggunakan statistik deskriptif. Hasil penelitian menunjukkan bahwa kesalahan ejaan masih sangat umum terjadi, terutama pada kosakata ilmiah yang panjang, kompleks, dan jarang digunakan dalam komunikasi sehari-hari. Faktor yang paling dominan meliputi transfer bahasa pertama, kurangnya pengetahuan leksis ilmiah, minimnya paparan terhadap konvensi ortografi bahasa Inggris, serta keterbatasan pengalaman dalam penulisan ilmiah berbahasa Inggris. Temuan studi juga menunjukkan bahwa mahasiswa memiliki tingkat kesadaran yang tinggi mengenai pentingnya ejaan sebagai sumber kejelasan dan kredibilitas dalam laporan akademik, namun kesadaran ini tidak selalu tercermin dalam tulisan yang mereka hasilkan. Selain itu, mahasiswa masih sangat bergantung pada layanan eksternal seperti pemeriksa ejaan. Strategi perbaikan yang digunakan umumnya masih bergantung pada dukungan eksternal dibandingkan upaya mandiri untuk membangun perkembangan ejaan yang lebih autonom. Temuan ini menunjukkan bahwa diperlukan penguatan instruksi terkait ejaan bahasa Inggris dan peningkatan praktik penulisan ilmiah untuk meningkatkan akurasi ejaan mahasiswa kimia sebagai penulis akademik EFL.

Kata Kunci: *chemistry students; error analysis; scientific writing; spelling accuracy; spelling errors*

Abstract

The research examines widespread spelling mistakes in chemistry students' laboratory reports, the factors that influence them, and the degree of accuracy in scientific writing. The research design for this study was quantitative and descriptive narrative, and the study was conducted with 58 chemistry students from various universities in Indonesia. Using a 35-item Likert-scale questionnaire, data were collected and analyzed using descriptive statistics. The results show that spelling errors are still very common, especially in long, complex scientific words that are rarely used in everyday language. The foremost among these are first-language transfer, insufficient knowledge of scientific lexis, lack of exposure to English orthographic conventions, and limited access to scientific writing. The evidence demonstrates that students have a high level of awareness of spelling as a source of clarity and credibility in academic reports, yet at times this awareness is not reflected in their writing. They are also dependent on external services, for example, spell-checkers. Their strategies for improvement generally rely on external support rather than on their own resources to foster autonomous spelling development. These findings demonstrate that stronger instruction in English spelling and more intensive scientific writing practice are needed to improve chemistry students' spelling accuracy as EFL academic writers.

Keywords: *chemistry students; error analysis; scientific writing; spelling accuracy; spelling errors*

INTRODUCTION

In modern academia and science, English is the language of global communication, allowing scientists to share their results, collaborate internationally, and access resources (Hyland, 2016; Flowerdew, 2015). Especially in science education, students are required to be competent in English to engage in international academic communication and to improve career prospects (Arapah, 2023). Writing academic documents in English, such as laboratory reports, research papers, and theses, is a requirement in virtually all universities, and thus the capability to write scientifically in English is a fundamental skill for professional and academic progression (Barrass, 2002).

Although non-native speakers have exposure to English, they still struggle to produce accurate scientific writing, with spelling mistakes among the most frequent issues (Gouvea et al., 2022; Osborne et al., 2023; Adoniou, 2022; Betteridge, 2022). Such mistakes may be attributed to L1 interference, a lack of scientific vocabulary, unfamiliarity with English orthographic rules, and a lack of scientific writing experience (James, 2013; Burt, 2021; Putri & Lestari, 2023). While spell-check software is readily available, reliance on the technology cannot completely resolve the root causes of errors when they are deeply rooted in cognitive and linguistic factors (Adoniou, 2014; Burt, 2021). Therefore, investigating the patterns and sources of spelling errors would be essential to enhancing the clarity, professionalism, and credibility of students' scientific writing.

In the context of chemistry education, spelling accuracy is not merely a linguistic concern but a core component of students' scientific literacy. Chemistry laboratory reports function as formal academic documents through which students communicate experimental procedures, data interpretation, and scientific reasoning. Inaccurate spelling—particularly in chemical terminology and technical vocabulary—can obscure meaning, reduce the precision of scientific explanations, and negatively affect the assessment of students' laboratory work. Consequently, spelling accuracy directly influences the quality of chemistry learning outcomes and the effectiveness of written evaluation in undergraduate chemistry courses.

Theoretical frameworks such as Error Analysis, Interlanguage Theory, and English for Specific Purposes (ESP) form the basis of this research. Error Analysis considers learner errors (including spelling errors) as indicators of the learner's current language knowledge and learning process, rather than as mere failures (Richards, 1974; Ellis, 2021). Interlanguage Theory argues that errors result from an intermediate linguistic system that is temporary and influenced by the learner's first and target languages, which explains the occurrence of systematic, recurrent errors (Selinker, 1972; Ellis, 2021). ESP advocates the need to teach English for particular disciplines, integrating discipline-specific content such as technical terms in science and other disciplines, and to teach writing and reading that will assist learners in producing accurate and precise academic texts (Hutchinson & Waters, 1987; Hyland, 2022).

Findings of studies on text production suggest that motivation and anxiety strongly affect spelling and writing quality in students. Error rates decreased with higher motivation and increased with higher anxiety (Albert, 2022; Horwitz, 2010; Dörnyei & Ryan, 2023; Taye & Mengesha, 2024). Intervention through explicit spelling instruction, peer review, and repeated exposure to academic vocabulary through controlled writing practice reduces mistakes and fosters deeper spelling awareness (Betteridge, 2022; Alasmari, 2022; Nugraheni, 2021). In addition, a

combination of phonological, morphological, and orthographic information facilitates the long-term retention of spelling patterns and supports precise scientific writing (Burt, 2021; Gledec et al., 2023)

Although the need for correct orthography in scientific writing is well recognized, it remains limited. Studies have been conducted on general writing proficiency for EFL learners; however, the distinct difficulties in a genre such as scientific writing (e.g., the use of complex and multi-syllabic terms and the limited access to domain-specific vocabulary) have not attracted much research attention (Hyland, 2004; Day & Gastel, 2012; Rahman, 2020). Spelling errors in these registers are said to hide scientific ideas, undermine the professionalism of reports, and cast doubt on their reliability (Barrass, 2002; Nugraheni, 2021). Classroom observations at the Faculty of Science and Technology at UIN Syarif Hidayatullah Jakarta, it is found that there are similar spelling errors such as "environment → enviroment," "receive → recieve," and "accommodate → acomodate" which are affected by first language interference, limited vocabulary knowledge, lack of proofreading, and cognitive focus on content rather than form (Putri & Lestari, 2023; Lee & Park, 2022; Kellogg, 2021; Zhang, 2024).

In this study, spelling errors in chemistry laboratory reports written by students were categorized and analyzed; students' awareness of spelling correctness was evaluated; and effective learning and teaching methods were suggested. When errors such as omission, addition, substitution, or transposition of letters occur, researchers can analyze them for patterns and areas of difficulty, which can inform interventions that target the underlying causes rather than the surface manifestation of the error (Richards, 1974; Ellis, 2008). Teachers can address these factors and incorporate direct spelling instruction, peer assessment, guided editing, and technology-based learning feedback (Graham & Harris, 2018; Betteridge, 2022) by understanding the impact of L1 interference, limited vocabulary, cognitive load, and teaching methodologies on students' spelling performance. In sum, this paper is expected to enhance the spelling accuracy of chemistry students as EFL writers and contribute to clearer, more professional, and credible scientific writing.

This study offers a novel contribution by focusing specifically on spelling errors in English laboratory report writing by chemistry students across multiple universities. Unlike previous EFL studies that primarily examine general writing tasks, this research situates spelling accuracy within the disciplinary context of chemistry education, addressing an underexplored intersection between language proficiency and scientific writing practices.

RESEARCH METHODS

Design

This research employed a quantitative descriptive survey design to investigate the types, causes, and awareness of spelling errors among chemistry students in Indonesia. A quantitative descriptive survey is appropriate for statistically describing the characteristics, behaviors, and perceptions of a defined population (Creswell, 2014). In this study, the design allows researchers to gather measurable data regarding the frequency and patterns of spelling errors, as well as factors influencing these errors. The use of structured questionnaires ensures uniformity in data collection and enables statistical analysis that yields clear and quantifiable findings (Fraenkel, Wallen, & Hyun, 2012). Therefore, this design provides an accurate quantitative description of students' spelling behaviours and contributing factors.

Participant

The participants of this research consisted of 58 chemistry students from various universities across Indonesia, including UIN Syarif Hidayatullah Jakarta, Universitas Jenderal Achmad Yani, Universitas Pendidikan Indonesia (UPI), Universitas Gadjah Mada (UGM), and UIN Sunan Gunung Jati. All participating students were first-semester chemistry students, representing early-stage exposure to English scientific terminology and scientific writing practices.

A purposive sampling technique was used to ensure that participants had foundational relevance to the study, particularly through initial engagement with English used in scientific contexts, even if they had not yet taken advanced courses such as English for Science or Technical Writing. Their early-stage academic experience provides meaningful insight into spelling challenges commonly encountered by beginning chemistry students. All participants voluntarily took part in the study after being informed about its purpose and were assured that the data collected would be used solely for academic research.

Research Instrument

The research instrument used in this study was a structured questionnaire consisting of 35 Likert-scale items (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree). The questionnaire was developed based on established theoretical frameworks, including Error Analysis Theory, Interlanguage Theory, and English for Specific Purposes, to ensure that each item accurately reflected the core variables investigated in the study (Cohen, Manion, & Morrison, 2017). The instrument was divided into four sections aligned with the research questions: (1) common types of spelling errors, (2) causes of spelling errors, (3) students' awareness of spelling accuracy, and (4) strategies to reduce spelling errors, the latter of which was adopted as a mandatory component in this study. All 35 items were closed-ended, enabling uniform quantitative data collection and eliminating the need for open-ended responses.

To ensure content validity, the questionnaire items were reviewed through expert judgment by lecturers with expertise in English language teaching and English for Specific Purposes (ESP). The experts evaluated the relevance, clarity, and alignment of each item with the research objectives, resulting in minor revisions to improve item precision.

The reliability of the instrument was assessed through internal consistency analysis. The results indicated that the questionnaire demonstrated acceptable reliability for descriptive survey research, suggesting that the instrument consistently measured students' spelling practices, awareness, and perceived causes of spelling errors.

The questionnaire was written in clear and accessible English to ensure comprehension among participants, considering that English is not their first language. The use of plain and straightforward language helps minimize misinterpretation and enhances the reliability of responses (Fraenkel, Wallen, & Hyun, 2012). Additionally, a structured and standardized format strengthens the consistency of data collection across participants, making the instrument suitable for descriptive statistical analysis.

Data Collection Procedures

Data were collected through an online questionnaire distributed via digital platforms such as WhatsApp groups, academic email lists, and student communication channels. These distribution methods were chosen to ensure accessibility for participants from various universities across Indonesia, allowing them to complete the survey conveniently. Online

administration enables efficient data distribution and collection across diverse geographic locations (Creswell, 2014).

Participants were given one week to complete the questionnaire, providing them ample time to understand each item and respond thoughtfully. Adequate completion time contributes to more accurate and reliable responses (Ary, Jacobs, & Sorensen, 2010). Prior to participation, students received an explanation regarding the study's objectives, confidentiality procedures, and voluntary nature of participation. Ethical principles—such as anonymity, informed consent, and protection of participant privacy—were adhered to throughout the process (Israel & Hay, 2006).

All responses were automatically recorded through Google Forms and exported into spreadsheet format for organization and preparation for statistical analysis. Proper digital management of survey data minimizes human error and ensures the dataset remains accurate, structured, and analysis-ready (Fraenkel, Wallen, & Hyun, 2012). Before further processing, the exported dataset was reviewed to verify consistency, detect potential anomalies, and ensure the data met the required standards for reliable statistical interpretation.

Data Analysis

The data obtained from the 35-item Likert-scale questionnaire were analyzed using descriptive statistical techniques. Descriptive statistics, including frequencies, percentages, and mean scores, were employed to identify the most common types of spelling errors, the dominant causal factors, students' levels of awareness regarding spelling accuracy, and the strategies they reported using to minimize such errors. The data were processed using Microsoft Excel 2019. Likert-scale responses were coded numerically from 1 (strongly disagree) to 5 (strongly agree), and mean values were calculated to determine the level of agreement for each item. These statistical procedures provide a clear numerical representation of students' patterns, tendencies, and perceptions related to spelling practices in English scientific writing (Fraenkel, Wallen, & Hyun, 2012).

Since all questionnaire items were closed-ended, the analysis was entirely quantitative, and no qualitative coding or thematic interpretation was required. The interpretation of mean scores followed a standardized categorization in which values of 1.00–2.49 indicated low levels, 2.50–3.49 indicated moderate levels, and 3.50–5.00 indicated high levels of spelling-related awareness and difficulties. The use of purely quantitative data analysis supports the study's descriptive survey design by allowing researchers to present findings concisely and objectively through numerical indicators (Creswell, 2014). This analytical approach ensures that the resulting descriptions accurately reflect the distribution of spelling-related issues among chemistry students.

The variables examined in this analysis were aligned with theoretical frameworks concerning spelling accuracy, such as Error Analysis Theory and Interlanguage Theory. These frameworks helped guide the interpretation of statistical findings by linking identified error patterns with factors such as first-language influence, vocabulary limitations, and writing practice habits (Selinker, 1972; Nation, 2013; Graham & Harris, 2018). These theoretical perspectives served not only as a conceptual guide but also as an analytical lens for interpreting the numerical results, allowing the study to connect statistical patterns with established explanations of second-language spelling development.

RESULT AND DISCUSSION

Result

Table 1 summarises the results for RQ1, which focused on identifying the most frequent categories of spelling errors committed by students in English chemistry report writing. The illustration of the dominant error patterns using this data can assist in enhancing the teaching of science.

Table 1 : Common Types of Spelling Errors in Chemistry Report Writing

Category	Causes Types of Spelling Errors Students' Awareness of Spelling Accuracy	Mean
Highest	"I often misspell long or complex technical chemistry terms."	4.00
Lowest	"I often misspell words that have similar sounds (e.g., ion and iron)."	2.00
Highest	"I realize that spelling mistakes can affect the grading of my report."	5.00
Lowest	"I feel confident in my ability to spell scientific terms correctly."	3.00

According to the table, spelling errors are most frequently found in long and complex chemistry terms. This suggests that students experience greater difficulty when dealing with technical terminology. In contrast, errors related to words with similar pronunciation occur less often, indicating that phonetic confusion is not a major issue in chemistry report writing.

Table 2 summarises the results for RQ2, namely 'factors affecting spelling errors in English chemistry writing', presented in Table 2. Knowing these reasons is critical to developing efficient preventive measures in the teaching of academic writing.

Table 2 : Causes of Spelling Errors in Chemistry Report Writing

The results show that the leading cause of errors is unfamiliarity with writing chemistry in English. Meanwhile, fast typing without paying attention to spelling has the least influence. These results highlight that the root of the problem is not technical typing habits but insufficient exposure to and practice with language.

Table 3 presents the results for RQ3, addressing students' perceptions of the significance of spelling accuracy in scientific writing. The data sought to examine how well students recognise the implications of spelling errors for the quality of academic work.

Table 3 : Students' Awareness of Spelling Accuracy in Chemistry Report Writing

The results indicate that students are highly aware of the effect of spelling errors on report marking. Nevertheless, their level of confidence in spelling scientific terms correctly was moderate. This finding suggests that, in spelling, there is a mismatch between what students know they should be doing and what they can actually do.

Table 4 presents the findings for RQ4, which concerned the strategies students employed to minimise spelling errors when writing science in English. This is valuable information on which to base decisions about strategies to promote and support teaching.

Table 4 : Strategies to Reduce Spelling Errors in Chemistry Report Writing

Category	Causes of Spelling Errors	Mean
Highest	"I am not accustomed to writing chemistry terms in English."	4.00
Lowest	"I often type quickly without paying attention to spelling."	2.00

Category	Strategies to Reduce Spelling Errors	Mean
Highest	"I feel that regular writing practice helps reduce my spelling errors."	5.00
Lowest	"I make a list of chemistry terms that I often misspell to review them again."	3.00

According to the table, regular writing is considered the best of these writing strategies for reducing spelling errors. By contrast, making a list of common misspellings of chemistry words is much less common. This result indicates that practice-based methods are preferred over memorisation-based methods.

Discussion

The results indicate that students experience difficulties with spelling phonologically similar words, orthographic interference from Indonesian, the omission or addition of double letters, incorrect word endings (–tion, –sion, –cian), capitalization, and misspellings of long, complex chemistry terms. These tendencies also conform to the systematic categorization of errors in writing proposed by James (1998), which includes, among other things, the confusion of form and sound in words. Besides, linguistic relativity of first-language interference, as proposed by Cook (1997), helps explain the possible influence of Indonesian orthography on English spelling performance, as the two orthographies are vastly different: Indonesian is regarded as a quite transparent orthography, while English is a deep orthographic system. In scientific writing, these problems are exacerbated by the specialized and infrequent nature of chemistry terminology. According to Basturkmen (2010), ESP learners face challenges with technical vocabulary because they are not sufficiently exposed to it outside their academic environment. Recent research also substantiates that spelling errors in STEM discipline writing are mainly related to complex terminology and low D-Literacy (Huang, 2021; Teng & Zhang, 2022).

The findings suggest that spelling errors can be attributed to students' unfamiliarity with English chemistry terms, infrequent proofreading, confusion between pronunciation and spelling, limited use of spelling-supporting tools, and limited practice in academic writing. Nation (2001) points out that true development of spelling is promoted by multiple exposures to and meaningful treatment of vocabulary, and that this kind of involvement in vocabulary and spelling is not provided to participants. Brown (2001) also maintains that the accuracy of writing is enhanced by lengthy practice coupled with concentrated attention to linguistic form. In addition, the students' inclination to attend to the content rather than to language accuracy mirrors what Richards (1974) calls errors related to performance, which are errors that result from partial knowledge of the language being incompletely realized due to cognitive pressures. A recent line of empirical evidence corroborates this account, suggesting that EFL students pursuing scientific majors tend to pay more attention to conceptual accuracy than to linguistic accuracy (Alhassan & Ali, 2020; Li & Casanave, 2023).

Despite these challenges, the results indicate that students have a strong sense of the need for correct spelling in scientific reports. The majority of the students are aware that spelling mistakes affect grading and the precision of scientific writing, and they also recognize disparities between the Indonesian and English spelling systems. This aligns with Hyland (2004) in that it is considered that academic writers do have an understanding of the disciplinary conventions and expectations, but may not

be able to confidently or consistently achieve them. Dörnyei (2001) characterizes this state as a discrepancy between metalinguistic awareness and performance. Recent research also indicates that awareness alone is insufficient to guarantee accuracy unless it is supported by appropriate learning strategies and sustained practice (Zhang & Qin, 2021; Nguyen, 2024). In other words, the results suggest that the students' awareness of spelling accuracy in chemistry writing has not been translated into stable spelling performance.

Students appear to rely predominantly on external rather than internal resources, including spell-check programs, peer and lecturer feedback, reading texts aloud, and using online dictionaries. These strategies, while useful, are mostly reactive and corrective rather than developmental. Hyland (2006) emphasizes the importance of feedback when writing for academic purposes, yet Basturkmen (2010) notes that ESP students still need direct instruction in language elements pertinent to their discipline. In addition, Brown (2001) and Nation (2001) argue that continuous writing and intentional vocabulary learning are indispensable for long-term spelling improvement. Several recent reports uphold this belief and also indicate that strategy-based instruction, together with an autonomous learning attitude, contributes to more sustainable development of spelling accuracy (Sadeghi & Lari, 2022; Rahimi & Fathi, 2025). These results point to the need for students to move beyond reliance on corrective tools and towards more proactive, autonomous spelling strategies.

The discussion suggests that the nature of English spelling errors in chemistry writing is linguistically, cognitively, and disciplinary. When the results are discussed in relation to existing theories and recent empirical studies, this research contributes to the debate on spelling accuracy and the development of academic writing in ESP and EFL environments.

Pedagogical Implications for Chemistry Education

The findings of this study carry important implications for chemistry education, particularly in courses that require students to produce laboratory reports in English. Previous studies in chemistry education have emphasized that accuracy in scientific writing, including spelling and terminology, is an essential component of disciplinary literacy and laboratory report assessment (Barrass, 2002; Robinson et al., 2008; Shultz & Gere, 2015).

Since spelling errors frequently occur in technical and scientific terminology, chemistry lecturers may consider integrating spelling awareness into laboratory writing instruction rather than treating it solely as a language issue. For instance, assessment rubrics for laboratory reports can explicitly include spelling accuracy as part of scientific communication competence.

Additionally, collaboration between chemistry lecturers and English instructors through an English for Chemistry or ESP-based approach may help students develop greater sensitivity to discipline-specific vocabulary and orthographic conventions. Activities such as guided report writing, peer review focused on technical terms, and repeated exposure to key chemical vocabulary can support students in internalizing correct spelling patterns.

CONCLUSION

This is, to our knowledge, the first study to show that spelling remains a significant problem in the scientific English writing of chemistry students. The results reveal that students' misspellings are not random but predictable. These spelling errors can be grouped into several dominant types,

including phonological similarity, interference from the Indonesian spelling system, omission or addition of double letters, incorrect word endings such as *-tion*, *-sion*, and *-cian*, as well as misspellings of long and complex chemistry terms. Errors are also found in capitalization, pluralization, and the use of technical vocabulary, suggesting that students have not yet achieved full orthographic mastery in academic writing.

The results suggest that these spelling errors are due to students' inadequate knowledge of English scientific terms and a lack of practice in academic writing. Indeed, the students' lack of familiarity with specialized chemical terminology leaves them unsure how to spell words, especially when confronted with low-frequency scientific vocabulary. Moreover, because of limited opportunities to write outside class, students cannot consistently consolidate correct spelling patterns; as a result, spelling mistakes recur in their laboratory reports.

Another significant finding is that, while students have a strong understanding of why spelling accuracy is important for clarity, credibility, and academic assessment, this understanding does not consistently result in accurate writing. The frequent occurrence of spelling mistakes indicates a discrepancy between what students know about spelling rules and how they apply that knowledge in their writing.

Finally, the findings indicate that students use external and corrective strategies to solve their spelling problems, including spell-check software, online dictionaries, and feedback from peers or tutors. These strategies help reduce surface errors, but they are not sufficient to fully develop students' independent spelling competence. The study therefore finds that sustainable improvement in spelling accuracy may be achieved by employing more preventive and self-regulated spelling strategies, supported by continuous writing practice, and by giving special consideration to chemistry terminology.

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