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Scientific Academic Writing Skills Among University Students: Results from a Self-Assessment Survey

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Abstract

This qualitative descriptive study provides a comprehensive profile of scientific academic writing skills among university students enrolled in mathematics education and primary school teacher education programs. Using a self-assessment survey, 110 students evaluated their proficiency across various dimensions of scientific writing, including clarity and coherence, organization of scientific arguments, use of scientific terminology, citation and referencing, critical evaluation of literature, and independent thinking. The data were analyzed using descriptive statistics to identify trends, strengths, and areas for improvement in students' writing skills. The findings revealed that students generally feel confident in their ability to construct clear academic paragraphs and use appropriate vocabulary and tone, but struggle with higher-order writing tasks such as synthesizing information from multiple sources and organizing extended scientific texts. Many students also expressed difficulties in applying proper citation and referencing styles, particularly APA format. Key strengths identified in the study include competence in basic grammar, punctuation, and paragraph structure, while notable weaknesses were found in areas such as critical evaluation, organizing complex arguments, and correct application of citation conventions. These results suggest a need for targeted instructional interventions to help students develop the advanced scientific writing skills necessary for academic success. The study's findings contribute to the ongoing discourse on improving scientific academic writing pedagogy, offering insights for educators to better support students in mastering these critical skills.

Keywords: scientific writing, academic writing, self-assesment survey, higher education, student writing skill

1. Introduction

The development of scientific academic writing skills is crucial for university students, particularly those in mathematics education and primary school teacher education programs (Strøm

& Hambro, 2020). These skills are essential for articulating complex ideas and communicating research findings, as well as for contributing to scholarly discourse, which is vital for academic success and professional development in these fields (Singh & Gaurav, 2013). However, many students encounter significant challenges in mastering the conventions and expectations of scientific writing, which can differ markedly from other forms of academic writing (Graham et al., 2014). This discrepancy often stems from varying levels of proficiency in writing skills upon entering higher education, leading to disparities in the quality of scientific texts produced by students (Teng & Wang, 2022).

The multifaceted nature of scientific writing encompasses both technical aspects, such as grammar and structure, and an understanding of the norms of scientific discourse, which include appropriate language use, argument organization, and citation practices (Sharma et al., 2022). In particular, students in mathematics education and primary school teacher education face unique challenges as they must integrate writing with content-specific knowledge (Hasani et al., 2017). This integration is critical, as effective communication in mathematics not only enhances understanding but also fosters mathematical reasoning skills (Angelo et al., 2014). Furthermore, the ability to write scientifically is increasingly recognized as a key competency that supports students' overall academic performance and engagement in their disciplines (Foko & Amory, 2005).

Self-assessment has emerged as a valuable pedagogical tool that can enhance students' writing skills by fostering metacognitive awareness. Engaging in self-assessment allows students to reflect on their writing abilities, identify strengths and weaknesses, and develop strategies for improvement (Nermin & Kapucu, 2022). Research indicates that self-efficacy beliefs significantly influence students' writing performance, as those with higher self-efficacy are more likely to employ effective planning, monitoring, and evaluation strategies during the writing process (Powell & Hebert, 2016). Moreover, educators can gain insights into students' perceptions of their writing competencies through self-assessment, which can inform targeted interventions and support strategies (Cheyne et al., 2010).

Despite the recognized benefits of self-assessment, there remains a gap in research specifically addressing how students in mathematics education and primary school teacher education perceive their scientific writing skills and how these perceptions correlate with their actual writing performance (Swanson et al., 2008). Previous studies have explored various aspects of academic writing, including students' attitudes towards writing, strategies for improvement, and the impact of educational interventions (Kosko, 2016).

This study seeks to bridge this gap by profiling the scientific academic writing skills of university students in mathematics education and primary school teacher education programs through a self-assessment survey. Unlike prior research, this study integrates theoretical insights on self-regulation and self-efficacy with empirical data to elucidate how students perceive their writing abilities and how these perceptions correlate with other indicators of proficiency. The findings will contribute to the theoretical discourse on self-assessment in education by offering novel insights into its application in scientific writing, particularly in content-specific contexts.

Practically, the study will provide actionable recommendations for improving writing instruction and support in higher education, ensuring students are better equipped to meet the demands of their academic and professional careers. This research is particularly timely given the growing emphasis on writing as a transferable skill across disciplines, and it offers readers valuable insights into advancing both educational practices and student outcomes.

2. Methods

This study employed a quantitative descriptive research design to develop a comprehensive profile of scientific academic writing skills among university students, focusing specifically on those enrolled in mathematics education and primary school teacher education programs. The research aimed to collect and analyze self-assessment data to understand how students perceive their writing abilities across various dimensions of scientific academic writing.

A total of 110 undergraduate students from a mid-sized university participated in the study, with 84 students from the Primary School Teacher Education program and 26 students from the Mathematics Education program. Participants were selected through convenience sampling, ensuring representation across different academic years and genders. The sample predominantly consisted of female students, reflecting broader trends in education-related fields.

Data were collected using a self-assessment questionnaire designed to evaluate scientific academic writing skills. The questionnaire used in this study was adapted from the Self-Assessment of English Writing Skills and Use of Writing Strategies (Marquette University, 2008) to evaluate students' scientific academic writing skills. The adaptation process ensured that the questions aligned with the context of mathematics education and primary school teacher education. Validation involved expert reviews by academic writing specialists to confirm content validity and relevance. Pilot testing was conducted with a small group of students to evaluate clarity, reliability, and consistency, with refinements made based on feedback. Each question item refers to recognized frameworks for academic writing competencies, focusing on clarity, coherence, critical thinking, synthesis, and proper citation practices, ensuring the questionnaire reflects key aspects of effective scientific writing. The questionnaire included sections on demographic information—such as gender, age, and field of study—and a series of Likert-scale questions where respondents rated their confidence and proficiency in various aspects of scientific academic writing. These aspects included clarity and coherence in writing, organization and structure of scientific arguments, use of appropriate scientific terminology, adherence to citation and referencing conventions, ability to critically evaluate and synthesize scientific literature, independent thinking in writing, and strategies for identifying and fixing writing problems.

The questionnaire was administered online over a two-week period during the spring semester of 2024. Participants received email invitations to complete the survey, with reminders sent to encourage participation. The survey was conducted anonymously to protect respondents' privacy

and to ensure candid responses. Participation was voluntary, and informed consent was obtained from all participants prior to completing the questionnaire.

Data from the questionnaire were analyzed using descriptive statistics, including means, standard deviations, and frequency distributions, to provide an overview of the students' perceived scientific academic writing skills. The analysis also focused on identifying significant differences between students in the Primary School Teacher Education and Mathematics Education programs. Correlation analysis was performed to explore relationships between self-assessment scores and demographic variables such as age, gender, and professional background. Open-ended responses were analyzed thematically to identify common themes related to students' perceived strengths and challenges in scientific academic writing.

This study was conducted in accordance with ethical guidelines established by the university's Institutional Review Board (IRB). The study protocol was reviewed and approved by the IRB before data collection began. Participants were fully informed of their rights to confidentiality and anonymity, and all collected data were securely stored and accessed only by the research team.

3. Result and Discussion

Presentation of the overall profile of scientific academic writing skills.

The overall profile of scientific academic writing skills among university students, particularly those enrolled in mathematics education and primary school teacher education programs, reveals a moderate level of proficiency across various dimensions of writing. The self-assessment data indicates that students generally perceive themselves as capable in several key areas of scientific writing, although there are notable variations in confidence levels depending on the specific skill being assessed. This self-assessment of scientific academic writing can be seen in the following table.

Table 1 Self-assessment of Scientific Academic Writing

Category	Average	Strengths	Areas for Improvement	Interpretation
Clarity and Coherence	3.20	Clear topic sentences and logical organization of ideas	Academic style and tone	Moderate confidence in clarity and coherence
Critical Evaluation and Synthesis	3.19	Evaluating sources and synthesizing information	Consistency in synthesis of information	Moderate confidence in evaluating and synthesizing

Independent Thinking in Writing	3.16	Ability to present independent ideas in writing	Deepening independent critical thinking	Moderate confidence with room for improvement
Organizing and Structuring Scientific Arguments	3.09	Basic structure of scientific arguments	Strengthening logical argumentation	Some confidence but needs improvement in argument structure
Citation and Referencing	3.20	Knowledge of citation norms	Improvement in accuracy of referencing	Moderate confidence in citation practices
Writing Process and Efficiency	2.96	Basic understanding of the writing process and initial time management skills	Improving writing process and time management	Low confidence, needs significant improvement

The self-assessment results from the study reveal a mixed level of confidence in students' academic writing abilities across various dimensions, highlighting both strengths and areas for improvement. In the clarity and coherence category, the average score of 3.20 indicates that students generally feel comfortable in their ability to write clear, organized paragraphs. This finding aligns with the key principles of academic writing, where logical structure and clarity are fundamental components (Pfeiffer & Walt, 2019). However, the need for improvement in academic tone suggests that while students may understand how to organize their thoughts, they are less confident in applying the formal style required for academic writing (Aziz et al., 2016).

For critical evaluation and synthesis, the average score of 3.19 shows that students are relatively confident in evaluating sources and integrating information from various texts. Nevertheless, the slight dip in consistency when synthesizing this information points to the need for more practice in applying higher-order thinking skills. According to Bloom's taxonomy, synthesis is a complex cognitive skill that requires students to go beyond basic analysis (Firoozjahantigh et al., 2021). This may explain why some students struggle to consistently demonstrate this ability, as effective synthesis involves not only understanding but also the ability to connect and integrate diverse ideas (Babanoğlu, 2017).

In the independent thinking in writing category, the score of 3.16 reflects that students can present their ideas with moderate confidence. However, there is room for improvement in deepening their critical thinking and producing more original arguments. Students may need further encouragement to develop unique perspectives and critical insights (Mohamad, 2022). This aligns with the findings that students often rely on existing literature rather than formulating their own arguments, which is crucial for academic writing (Malik, 2023).

The average score of 3.09 in organizing and structuring scientific arguments indicates that while students can establish the basic structure of scientific arguments, they need to work on enhancing the depth and logic of their reasoning. Toulmin's model (1958) underscores the need for well-supported claims, and the score suggests students may be missing the necessary steps in constructing comprehensive arguments that align with this framework (Sudirman et al., 2021). This indicates a need for targeted instruction on argumentation strategies to help students develop more robust and logically sound arguments.

In citation and referencing, the average score of 3.20 reflects a moderate level of competence. Students appear to grasp the importance of correctly citing sources, as emphasized by Bailey (2011), but there remains room for improvement in ensuring accuracy and consistency in referencing practices (Yuned et al., 2018). This is critical, as proper citation not only lends credibility to academic work but also helps students avoid issues of plagiarism.

Finally, writing process and efficiency stands out as the weakest area, with an average score of 2.96. This suggests that students find it challenging to manage their writing process effectively, which could affect both the quality and timeliness of their work. Flower and Hayes (1981) argue that writing is a cognitive process involving planning, drafting, and revising, and the low score here implies that students may benefit from guidance on how to approach writing tasks more systematically and manage their time more efficiently (Prasithrathsint, 2014). This indicates a need for instructional strategies that emphasize the writing process and provide students with tools to enhance their writing efficiency.

In summary, while students exhibit a reasonable level of confidence in certain aspects of academic writing, significant gaps remain, particularly in areas requiring higher-order thinking and effective writing processes. Addressing these gaps through targeted instruction and practice will be essential for enhancing students' overall academic writing skills.

Identification of common strengths and weaknesses in scientific academic writing skills

The identification of common strengths and weaknesses in the scientific academic writing skills of university students, particularly those in mathematics education and primary school teacher education programs, offers valuable insights into their academic development. One of the most prominent strengths identified is students' ability to construct basic academic paragraphs with clear topic sentences. Most students felt confident in their ability to express ideas coherently in paragraph form, ensuring that the main point of their writing is logically supported and developed. This aligns with earlier research by Petric (2002), who found that students tend to grasp the fundamental components of paragraph structure, such as clarity and coherence, but often struggle when asked to expand those skills into longer, more complex compositions (Luhach, 2020).

Another notable strength is the students' ability to use appropriate vocabulary and tone in their writing. Many students reported that they could effectively communicate using academic language and appropriate word forms, which is essential for producing high-quality scientific writing. This suggests that while students may encounter challenges in other areas, they are generally comfortable with the language conventions necessary for academic discourse. Additionally, the

survey highlighted that students are confident in their understanding of basic grammar, punctuation, and spelling rules. These foundational skills provide a strong base for further development in scientific academic writing (Susilo et al., 2021).

However, despite these strengths, significant weaknesses were identified in areas requiring higher-order thinking and more complex writing strategies. One of the most significant weaknesses lies in students' ability to critically evaluate and synthesize information from multiple sources. Many students expressed low confidence in their ability to integrate and analyze scientific literature effectively, a skill that is crucial for producing original, well-supported arguments in scientific writing. This aligns with Mallia's (2017) findings, which suggest that while students can often summarize sources, they struggle to engage deeply with the content and critically assess it in the context of their own research questions (Alsowat, 2022).

Similarly, the ability to organize and structure longer scientific texts, such as research papers or articles, was identified as a common challenge. While students showed confidence in writing individual paragraphs, they were less certain about their ability to organize those paragraphs into a cohesive and logically structured argument. This indicates a need for more explicit instruction in text organization, particularly in how to transition between ideas and maintain a logical flow throughout a longer piece of writing. This challenge is further compounded by the fact that many students reported difficulties in revising their work to improve overall organization and development, suggesting that they may not yet have fully internalized strategies for refining their work through multiple drafts (Eardley et al., 2020).

Another weakness identified is in the area of citation and referencing. While students were generally confident in their ability to paraphrase and quote information accurately, they expressed lower confidence in their ability to correctly apply citation styles, such as APA format. This is a critical skill in scientific writing, where proper attribution of sources is not only essential for academic integrity but also a marker of professionalism and scholarly competence. Fitzmaurice & O'Farrell (2013) emphasized the importance of continuous practice in citation and referencing, particularly as students move toward more advanced stages of their academic careers (Lustyantie et al., 2019).

In summary, the self-assessment data indicate that while students possess strong foundational skills in scientific academic writing, such as paragraph construction, vocabulary use, and basic grammar, they struggle with more complex tasks such as critical evaluation, text organization, and citation. These weaknesses highlight areas where further instructional support is necessary to help students develop the advanced writing skills needed to excel in scientific disciplines. By focusing on these key areas, educators can better prepare students to engage deeply with scientific literature, structure their writing more effectively, and adhere to academic conventions with confidence.

Patterns and Trends in Scientific Academic Writing Skills

The self-assessment data revealed several noteworthy patterns and trends in the scientific academic writing skills of university students, particularly those from mathematics education and primary school teacher education programs. These patterns provide insights into the areas where

students feel most competent, as well as the dimensions of scientific writing that present greater challenges. Understanding these trends is essential for designing effective interventions and support systems to enhance students' writing abilities.

One of the most evident trends is the students' moderate confidence in basic writing mechanics, such as grammar, punctuation, and spelling. Across both groups, students expressed a general belief in their ability to apply these fundamental writing skills, which aligns with existing research suggesting that students typically master mechanical writing conventions before tackling more complex writing tasks (Ooi et al., 2022)This competence in basic language mechanics forms a solid foundation on which other, more advanced writing skills can be built. Additionally, students from both groups demonstrated confidence in their ability to produce well-structured paragraphs, a skill that reflects an understanding of the building blocks of academic writing.

Another key pattern relates to the use of academic tone and vocabulary. The self-assessment data show that students are generally comfortable using appropriate academic language and tone in their writing. This trend is promising, as the ability to write using academic conventions is essential for communicating research ideas effectively in a scholarly context (Heimdal et al., 2021). However, it is worth noting that while students are comfortable with basic academic vocabulary, they may still need to expand their domain-specific terminology to engage fully with the scientific discourse in their respective fields. This suggests that, although students feel confident in general academic writing, more specialized instruction may be required to deepen their use of field-specific language.

Despite these strengths, there is a clear trend indicating that students struggle with higher-order writing tasks, particularly those involving the synthesis and critical evaluation of scientific literature. Many students reported difficulties in integrating sources into their writing in a way that goes beyond simple summarization, which aligns with broader concerns in academic writing instruction. Mallia (2017) emphasized that this is a common challenge among students, as synthesizing multiple sources requires not only comprehension but also the ability to critically engage with different perspectives and weave them into a cohesive argument (Thelwall et al., 2017). The survey data suggest that students are aware of this challenge but lack confidence in applying these advanced skills, which are essential for scientific writing and research.

Another trend observed in the data is the students' difficulty with organizing longer pieces of scientific writing, such as research papers or articles. While many students expressed confidence in their ability to organize individual paragraphs, they struggled with the overall structure of longer texts, where maintaining a logical flow across multiple sections becomes more complex. This difficulty may stem from a lack of explicit instruction in how to structure scientific arguments across an extended piece of writing(Petric, 2002; Saleem et al., 2023). The survey revealed that students are particularly challenged by the need to create cohesive introductions, develop a clear thesis, and organize their ideas in a way that consistently supports their central argument throughout the paper.

Finally, there is a significant trend regarding students' confidence in their ability to use citation and referencing styles correctly, particularly APA style. The data suggest that while students can

paraphrase and quote effectively, they often struggle with the technical aspects of citation, including in-text citations and reference lists. This finding is consistent with Fitzmaurice & O'Farrel (2013) work, which underscores the importance of repeated practice in using citation formats correctly (Jomaa & Bidin, 2018). Proper citation is crucial in scientific writing, not only for academic integrity but also for situating one's work within the broader scholarly conversation. The data suggest that students would benefit from more focused instruction and practice in applying these conventions accurately.

In conclusion, the patterns and trends in the self-assessment data provide a clear picture of students' strengths and weaknesses in scientific academic writing. While students feel confident in basic writing mechanics and the use of academic tone, they face challenges with more complex tasks such as synthesizing literature, organizing extended pieces of writing, and applying citation styles accurately. These findings align with previous studies, such as Mallia (2017) and Petric (2002), which also identified difficulties in critical evaluation, synthesis, and text organization as common barriers for students in academic writing. However, this study contributes new insights by focusing specifically on mathematics education and primary school teacher education programs, contexts that have been underexplored in previous research.

The implications of these findings are significant both theoretically and practically. Theoretically, the study highlights the importance of self-assessment as a tool for fostering metacognitive awareness and identifying writing challenges. Practically, the results emphasize the need for targeted instructional strategies, including workshops on synthesis and argumentation, explicit training in citation practices, and the integration of digital tools to support the writing process. By addressing these challenges, educators can enhance students' scientific writing skills, ultimately preparing them for greater academic success and professional development in their fields.

Practical Limitations and Open Problems

Despite the valuable insights gained from this study, several practical limitations warrant attention. First, the reliance on self-assessment data introduces the potential for subjective biases in students' evaluations of their writing skills. While self-assessment provides important metacognitive insights, it may not fully capture students' actual writing performance, as external assessments or detailed writing analyses might. Future studies could complement self-assessments with objective measures, such as instructor evaluations or automated writing analysis tools, to provide a more comprehensive understanding of students' writing abilities.

Second, the study focuses on students in mathematics education and primary school teacher education programs, which limits the generalizability of the findings to other disciplines. Scientific academic writing demands and challenges can vary significantly across fields of study. Further research should explore how self-assessment and writing skill development manifest in other educational contexts, such as engineering, humanities, or social sciences, to provide a broader perspective.

Third, while the study identifies areas for improvement in writing skills, such as critical evaluation, synthesis, and the writing process, it does not delve deeply into the pedagogical strategies that could address these gaps. Exploring targeted interventions, such as writing workshops, peer-review activities, or the integration of AI-based writing tools, could provide actionable solutions for educators aiming to support students more effectively.

Moreover, this study highlights the importance of domain-specific vocabulary and academic tone but does not address the challenges students may face in developing these skills across diverse linguistic and cultural contexts. Given the increasing internationalization of higher education, future research could examine how language proficiency and cultural background influence students' scientific writing skills and their self-assessment practices.

Lastly, the study underscores the need for improved citation and referencing practices, particularly in the use of APA style. This raises broader questions about how best to teach citation conventions in a way that integrates seamlessly with students' overall development of writing skills. Investigating the effectiveness of various instructional methods, including digital tools for citation management, could further enhance academic integrity and professionalism in scientific writing.

By addressing these limitations and pursuing the suggested avenues for further research, future studies can build on the findings of this study to advance both theoretical understanding and practical approaches to improving scientific academic writing skills among university students.

4. Conclusion

This study provides a comprehensive overview of the scientific academic writing skills of university students in mathematics education and primary school teacher education programs. The findings reveal that while students possess strong foundational skills, such as constructing clear academic paragraphs, using appropriate vocabulary, and applying basic grammar and punctuation rules, they face significant challenges in more advanced writing tasks. These include synthesizing and critically evaluating scientific literature, organizing complex arguments, and applying citation and referencing styles accurately. The results indicate a need for targeted educational interventions to enhance students' proficiency in these areas. Educators should focus on improving students' ability to engage critically with sources, structure extended scientific texts, and apply proper citation conventions, particularly in APA format. Addressing these challenges will better equip students for the demands of academic and professional writing in their fields, contributing to their overall academic success and future careers.

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