# Analyzing elementary education students' understanding and needs for a digital guidebook of project-based scientific article writing

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## Abstract

This study investigates students' understanding of scientific article writing techniques, their perceptions of the challenges they face when writing these articles, and the features of guidebooks that best meet their needs. Employing a mixed-methods approach with a Convergent Parallel design, the research combines quantitative data collected through tests and questionnaires with qualitative insights from open-ended questions. The findings reveal that students' knowledge of scientific article writing falls into the moderate range (46%). While they demonstrate a good understanding of submitting articles to journals, they struggle with using AI applications, properly citing references, and documenting post-publication work. Students' primary challenges include articulating their research methodology, crafting effective sentences and paragraphs, structuring the article appropriately, utilizing AI technology during the writing process, and navigating the submission process to scientific journals. Furthermore, the study highlights students' desires for a guidebook that goes beyond theoretical discussions. They are looking for one that includes practical examples, video tutorials, project assignments, and guidance on using AI platforms to aid their writing. These insights significantly contribute to designing a scientific article writing guidebook tailored to the needs of Generation Z students, ultimately enhancing the quality of scientific writing education.

**Keywords:** *scientific writing skills; student needs; guidebook for writing scientific articles; elementary education students*

## INTRODUCTION

The ability to write scientific articles is a key indicator of the academic skills that students need to effectively analyze and communicate their research findings (Pettoello-Mantovani et al., 2024; Spasennikov, 2020). However, studies reveal that many students struggle with understanding and applying the fundamental principles of scientific writing. This includes identifying gaps in existing research, clearly explaining data collection methods and analysis procedures, and presenting research outcomes effectively (Yelliza, 2024). These challenges are further exacerbated by the limited availability of university courses designed to enhance students' scientific writing skills (Abdikalyk et al., 2024).

Preliminary research has uncovered several challenges students face when writing scientific articles. These include the difficulties in locating and managing high-quality references, crafting effective sentences and paragraphs, paraphrasing others' ideas, developing a strong and relevant background for the problem, detailing specific research methods, and presenting and discussing research data comprehensively. Moreover, a study by Sahan et al. (2024) found that students particularly struggle with writing their research introduction, methods, and discussion sections. Complementing these findings, Kismiati (2024) pointed out that Biology education students often lack experience and face challenges, specifically in writing the introduction and research methods. Additionally, Alqahtani and Alhamami (2024) highlighted language proficiency and the integration of critical thinking as significant hurdles for students in this area. These obstacles underscore the urgent need for a more structured approach to teaching scientific article writing, which could include a comprehensive guidebook tailored to student needs.

The significance of this research is underscored by Yelliza's findings (2024), which highlight the necessity of tailoring learning materials to meet students' needs for effective learning facilitation. Furthermore, understanding students' needs is crucial in gaining insight into their actual abilities and challenges when tackling various tasks related to scientific article writing (Paliya et al., 2024). Berlian et al. (2023) further support this notion, indicating that the outcomes of student needs analysis serve as a vital resource for developing effective learning materials and curricula that resonate with the distinct characteristics of students. Ultimately, this research is essential as it provides valuable information that can guide the creation of scientific article-writing guidebooks and learning models that align with students' needs and expectations.

Generation Z students have a strong digital orientation, a preference for visual and interactive content, and a desire for hands-on engagement (Tirocchi, 2023). They are also highly digitally literate, quick decision-makers, and receptive to innovation, so guidebooks that suit their needs should incorporate digital tools and platforms that can effectively engage them (Pašiušienė et al., 2023). In addition,

Generation Z's preference for teamwork and interactive learning environments suggests that guidebooks for scientific article writing should include project tasks that encourage collaborative writing and peer review (Dania et al., 2023).

While prior research has focused on various student needs, a significant gap remains regarding the specific requirements for guidebooks on scientific article writing (Maknun et al., 2020; Yelliza, 2024). Previous studies primarily concentrated on aspects such as learning strategies (Desmarani et al., 2022), teaching and learning resources (Annisah et al., 2020; Asyura & Fitrawati, 2021), educational media (Sukartiningsih et al., 2022), and skills that fall outside the realm of scientific article writing (Puspita & Rosnaningsih, 2019; Syaifudin, 2024). Therefore, it is evident that this research topic holds significant uniqueness and novelty. Moreover, the findings from this research promise to offer valuable insights for developing teaching materials and learning models that support the improvement of scientific article writing skills (Bates, 2019).

Building on this background, this study addresses three key research questions: 1) What do basic education students understand about writing scientific articles? 2) How do these students view the challenges associated with this writing process? and 3) What features should a guidebook for writing scientific articles have to meet the needs of elementary education students effectively? By exploring these questions, this research not only highlights the needs of students but also paints a clearer picture of their knowledge and the obstacles they encounter in writing scientific articles.

## METHODS

This study employs a mixed-method approach, combining quantitative and qualitative elements to assess students' understanding of scientific article writing, their perspectives on the challenges faced during the writing process, and the features they desire in a scientific article writing guidebook (Vebrianto et al., 2020). The convergent parallel mixed-method design was selected to ensure that qualitative and quantitative data can complement one another and be directly compared (Creswell, 2014). In this research, quantitative data were gathered from comprehension tests and Likert scale questionnaires aimed at gauging students' views on the difficulties of writing scientific articles and the traits they seek in guidebooks that meet their needs. Additionally, qualitative data were collected through open-ended questions regarding the characteristics of the writing guidebooks that would best serve students, along with their suggestions for effective strategies to enhance their scientific writing skills.

The participants in this study were final-year students enrolled in the Madrasah Ibtidaiyah Teacher Education program. One hundred one students were selected through a random sampling method, with the selection criteria determined by a quota technique. All participants voluntarily completed an online form. The analysis revealed that out of the respondents, 78 (77%) were female and 23 (23%) were male. Their ages ranged from 20 to 23 years, with 10% being 20 years old, 53% at 21 years, 32% at 22 years, and 5% at 23 years old.

For this study, we utilized an online questionnaire crafted with Google Forms, which allowed us to reach a broad audience of students and simplified the analysis of their responses. The questionnaire was structured into four main sections. The first section included four questions to gather essential personal information: name (optional), gender, age, and semester. The second section contained 20 multiple-choice questions designed to assess eight vital aspects of writing scientific articles. These aspects encompassed identifying the features of scientific articles, constructing effective sentences and paragraphs, grasping scientific research methods, composing article content, citing references, leveraging AI tools, submitting articles to scientific journals, and documenting published articles in these journals.

The third section includes eleven Likert Scale items that explore students' perceptions of the challenges involved in various scientific article writing activities. These activities encompass selecting an engaging and suitable topic, crafting a logical and persuasive introduction, constructing coherent sentences and well-organized paragraphs, succinctly and accurately describing research methods, analyzing data and presenting research findings, and navigating journal websites for essential information like writing guidelines and publication schedules. The section also addresses the processes of submitting manuscripts and managing the peer-review journey, utilizing Mendeley for reference management, leveraging Turnitin or similar tools to check for text similarity, quickly searching web databases for references, and employing artificial intelligence to aid in article writing. Each item on the Likert scale offers five response options: 1 = strongly disagree, 2 = disagree, 3 = undecided, 4 = agree, and 5 = strongly agree.

The fourth section includes six Likert scale items and two open-ended questions aimed at identifying the characteristics of scientific article writing guidebooks that meet students' needs and gathering suggestions for effective strategies to enhance their scientific writing abilities. Prior to using this instrument as a data collection tool, the items were reviewed by three experts in the education field to ensure their appropriateness, completeness, and clarity. Furthermore, the closed-ended questionnaire items will be tested with 40 individuals outside the research participants to assess their validity and reliability.

The research data encompasses quantitative and qualitative aspects, as the instrument includes closed and open-ended questions. Information regarding the respondents' general demographics is displayed using frequencies and percentages. Additionally, students' comprehension of scientific article writing was analyzed and interpreted according to a scoring categorization guide. This guide defines understanding levels as follows: a score of 0% to 33% indicates low understanding, 34% to 67% signifies medium understanding, and above 67% reflects high understanding (Diana et al., 2020).

For the Likert Scale results, we calculated the average scores and percentages, interpreting them using the established categorization guide: scores ranging from 1.00 to 2.33 correspond to a low level, 2.34 to 3.67 indicate a medium level, and 3.68 to 5.00 denote a high level of understanding (Alkharusi, 2022). The open-ended responses were analyzed by identifying emerging keywords, categorizing these keywords, and presenting them thematically, highlighting selected examples from the respondents' answers.

## RESULT

### 1. Students' Knowledge of Scientific Article Writing Techniques

The results of analyzing students' answers to 20 multiple-choice test items covering eight aspects of scientific article writing material show that students' level of knowledge about matters related to writing scientific articles is in the medium category, with an average accuracy of 46%. Details of students' knowledge levels can be seen in Table 1.

Table 1. Students' level of knowledge of scientific article writing

| No. | Aspect | Accuracy | Categories |
|---|---|---|---|
| 1 | Submission of articles to scientific journals | 77% | High |
| 2 | Introduction to the characteristics of scientific articles | 66% | Medium |
| 3 | Writing the substance of the article | 58% | Medium |
| 4 | Research Methodology | 47% | Medium |
| 5 | Sentence and paragraph writing | 42% | Medium |
| 6 | Use of AI applications | 29% | Low |
| 7 | Citation and reference writing | 24% | Low |
| 8 | Post-publication documentation of the article | 23% | Low |
| | **Average** | **46%** | Medium |

Table 1 demonstrates that submitting articles to scientific journals scored quite well, with an accuracy rate of 77%, suggesting that students possess a solid grasp of the publication process. However, several other areas fall into the medium category. For instance, understanding the characteristics of scientific articles

received a score of 66%, while writing the article's content was rated at 58%. Additionally, research methodology scored only 47%, and constructing sentences and paragraphs garnered a low 42%. These figures indicate that many students struggle with comprehending scientific research methods, the ideal criteria for scientific articles, and effectively writing the content coherently.

The findings indicate that the use of AI applications (29%), writing citations and references (24%), and documenting post-published articles (23%) fall into the low-performance category. This suggests that many students struggle to effectively utilize AI in scientific writing, manage citations and references correctly, and appropriately document post-published articles on suitable social media platforms to enhance visibility and citations. These results highlight the pressing need to boost students' skills in crafting scientific articles. Key areas for improvement include research methodology, articulating the core substance of scientific articles with clarity, properly handling citations and references, and leveraging digital technology and AI applications to aid the writing process.

## 2. Students' Views on the Difficulty of Writing Scientific Articles

The findings of this study indicated that, overall, students regarded the difficulty level of writing scientific articles as moderate, with 50% of respondents agreeing and an average score of 2.49. For a more detailed look at students' perspectives on the challenges of writing scientific articles, please refer to Table 2.

Table 2 reveals that students face significant challenges when it comes to writing scientific articles, particularly in areas such as data analysis and presenting research findings (58%, mean 2.92), crafting logical and compelling introductory sections (54%, mean 2.72), selecting engaging and relevant topics (53%, mean 2.66), and creating cohesive sentences and well-structured paragraphs (53%, mean 2.63). These challenges highlight the need for more support in developing research ideas, organizing arguments coherently, interpreting data effectively, and writing clear and impactful sentences and paragraphs.

Conversely, students reported relatively low difficulty with the technical aspects of using technology. For instance, they found using Mendeley to manage references manageable (43%, mean 2.16), employing Turnitin or a text similarity checking tool (45%, mean 2.26), quickly locating references via journal databases (44%, mean 2.22), and utilizing artificial intelligence to assist in writing articles (48%, mean 2.42). These findings suggest that students may still be unfamiliar with or lack the necessary skills to effectively use software and digital resources to enhance their academic writing. As a result, this study highlights the urgent need to bolster students' conceptual and technical skills in writing scientific articles.

Table 2: Students' views on the difficulties of writing scientific articles

| No. | Activity Aspect | Percentage | Mean | Categories |
|---|---|---|---|---|
| 1 | Analyze data and present research results | 58% | 2,92 | Medium |
| 2 | Write a logical and argumentative introduction to a scientific article | 54% | 2,72 | Medium |
| **3** | Determine an interesting and appropriate topic | 53% | 2,66 | Medium |
| 4 | Stringing sentences and composing good paragraphs | 53% | 2,63 | Medium |
| 5 | Submitting the manuscript and following the peer-review process | 52% | 2,58 | Medium |
| 6 | Describe research methods concisely and accurately | 50% | 2,50 | Medium |
| 7 | Using artificial intelligence to help with article writing | 48% | 2,42 | Medium |
| 8 | Searching for important information on the journal's website, such as writing guidelines, publication schedule, etc. | 45% | 2,26 | Low |
| 9 | Use Turnitin or similar to check text for similarity | 45% | 2,26 | Low |
| 10 | Using web databases to find references quickly | 44% | 2,22 | Low |
| 11 | Using Mendeley to manage reference data | 43% | 2,16 | Low |
| | **Average** | **50%** | **2,49** | **Medium** |

## 3. *Characteristics of the Guidebook for Writing Scientific Articles by Student Needs*

The analysis of student responses indicates that the scientific article writing guidebook effectively meets students' needs in the areas evaluated. Notably, each aspect received a high rating, with students giving an impressive 81% and an average score of 4.05, placing it in the high category. For a detailed breakdown of students' perspectives on the ideal features of scientific article writing guidebooks, please refer to Table 3.

Table 3 reveals that students fundamentally desire specific characteristics in their learning materials. Among these, easy-to-follow examples stand out, with 87% of respondents agreeing (mean = 4.36). Following closely, 84% expressed a preference for illustrative images and video tutorials (mean = 4.20), while 83%

highlighted the importance of incorporating digital technology and artificial intelligence (AI) in scientific writing (mean = 4.17). Furthermore, 76% of students indicated they would value a guidebook offering project-based assignments (mean = 3.80) and exercises aimed at testing their understanding (74%, mean = 3.68). Students also showed a clear preference for digital formats, which garnered 82% support and a mean of 4.09. In summary, the findings of this study indicate that effective guidebooks for scientific article writing should be digital, interactive, infused with AI technology, and rich in examples, illustrations, and video content to cater to student needs truly.

Table 3. Features of writing guides for scientific articles that effectively meet students' needs.

| No. | Aspect | Percentage | Mean | Categories |
|-----|--------|-----------|------|-----------|
| 1 | Includes easy-to-follow examples. | 87% | 4,36 | High |
| 2 | Supported with illustrations and video tutorials. | 84% | 4,20 | High |
| 3 | Discusses the use of digital technology and artificial intelligence | 83% | 4,17 | High |
| 4 | Packaged in digital format. | 82% | 4,09 | High |
| 5 | Includes project-based assignments. | 76% | 3,80 | High |
| 6 | Accompanied by practice questions. | 74% | 3,68 | High |
| | **Average** | **81%** | **4,05** | **High** |

Examining students' responses to open-ended questions revealed that an effective guidebook for writing scientific articles tailored to basic education students should be straightforward, clear, and organized. This clarity helps students grasp the content quickly. Many responses underscored the need for a guide that uses "straightforward" language and gets to the point. For instance, one student pointed out that the guidebook "*should be direct, convey a single meaning, remain unemotional, and avoid any ambiguous interpretations.*" This straightforward approach is crucial in allowing readers to hone in on the main ideas without getting sidetracked or confused.

Many respondents emphasized the significance of delivering material in a straightforward yet thorough manner. For instance, one suggested that "*guidebooks should be written in a light and accessible language.*" It's important to clarify any unfamiliar terms that might pose challenges for understanding. This approach ensures that the guide can benefit students from various backgrounds, especially those who might be new to writing scientific articles. Moreover, students pointed out the importance of the guidebook's structure, with comments like "*more explanation of the key points that should be included in the background and tips on how to kick off a paragraph.*" This indicates that a guidebook offering structured explanations—from the introduction to the conclusion—can help students navigate the writing process without feeling lost.

To facilitate a smoother learning experience, students proposed that the guidebook for writing scientific articles should include practical examples, illustrations, and video tutorials. One student highlighted this need, stating, "*There should be relevant examples to make the material easier to understand, and in today's age, learning through videos is much more engaging.*" Additionally, many students expressed their desire for the guidebook to feature insights into digital applications or tools that can assist in writing scientific articles. As one student pointed out, "*It would be great to have a digital-based guide that includes video tutorials, utilizes AI, is project-oriented, and offers online support.*"

In discussing the students' views on effective strategies for improving their scientific writing skills, many emphasized the significance of reading a wide range of books, journals, and articles. This foundational step helps them grasp the structure and style typical of scientific writing. Furthermore, they recognized the value of consistent writing practice, along with attending workshops or training sessions to enhance their skills. One student pointed out, "*To improve, we should read extensively and make the most of smart technology for learning.*"

The students expressed that collaborating with experts in their fields, such as lecturers and mentors, could significantly enhance their skills in writing scientific journal articles. One student highlighted this by noting, "*I often consult with people who specialize in my area.*" This insight underscores how interacting with experienced individuals can provide valuable feedback and speed up the learning process. Overall, the students' comments suggest that the guidebook they envision would not only facilitate the writing of articles but also motivate them to create impactful scientific work.

## DISCUSSION

### 1. Students' Knowledge of Scientific Article Writing Techniques

The findings of this study indicate that students' understanding of scientific article writing falls within the medium range, with an average accuracy of 46%. While their grasp of the procedures for submitting articles to scientific journals is relatively high at 77%, other critical areas, such as research methodology (47%), article content writing (58%), and the structure of sentences and paragraphs (42%), need substantial improvement. This aligns with Yelliza's (2024) observations, which noted that students often struggle to craft a compelling problem background, articulate research methods clearly, and effectively present research findings.

Furthermore, many students struggle to fully grasp how to use artificial intelligence (AI) applications effectively in academic writing, citation and reference management, and post-editing tasks, with only 29%, 24%, and 23% understanding these areas, respectively. This indicates that they face significant hurdles when it

comes to leveraging technology to enhance their scientific writing process. In our digital age, tools like Mendeley, Turnitin, research databases, and AI platforms can greatly boost the efficiency and quality of academic writing (Altmäe et al., 2023; Dabella Yunia et al., 2022; Kacena et al., 2024; Sozon et al., 2024). Additionally, this lack of familiarity aligns with the findings of Alqahtani (2024) and Lama (2024), who highlighted that students often find it challenging to combine critical thinking with language skills in their academic writing.

This finding carries significant implications for the development of curricula and learning strategies. Rooted in social constructivism theory, it is essential to encourage students to engage in collaborative learning, supported by guidance from lecturers or mentors as they prepare scientific articles Charmaz (2020). Moreover, adopting a project-based learning approach can enhance students' abilities throughout every phase of writing scientific articles, from researching references to the publication process (Indriyani et al., 2023). Additionally, the guidebook developed should take into account the role of technology and digitalization, ensuring it meets the needs of Generation Z students, who are inherently digitally oriented (Tirocchi, 2023).

## 2. *Students' Views on the Difficulties of Writing Scientific Articles*

The findings of this study indicated that students faced moderate challenges when it came to writing scientific articles, with 50% reporting difficulties. The primary issues identified were in the areas of data analysis and the presentation of research findings (58%), crafting a logical and persuasive introduction (54%), and selecting engaging and suitable topics (53%). These results align with the research of Sahan et al. (2024), which highlighted that students frequently struggle with writing the introduction, methodology, and discussion sections of their research.

Students often struggle with writing introductions due to their limited experience in identifying gaps in existing research, as noted by Kismiati (2024). Similarly, difficulties in data analysis and presenting research findings can stem from a lack of understanding of research methods and suitable data analysis techniques. According to Bloom's theory, analytical skills are categorized under Higher Order Thinking Skills (HOTS), which means that achieving proficiency in these areas requires ample practice and hands-on experience (Adesoji, 2018; Krathwohl, 2002).

The findings reveal that students struggle with using essential technologies for scientific writing. Common challenges include searching for references in journal databases, utilizing Turnitin for text similarity checks, and leveraging AI tools for drafting scientific articles. These obstacles highlight the urgent need for enhanced training in academic digital literacy. Berlian et al. (2023) have pointed out the crucial role of adapting to technological advancements within academia.

Given this context, there is a clear call for more engaging and practical learning methods when it comes to teaching scientific writing techniques. Implementing case study-based learning models and technology-focused training could help students better grasp the structure of scientific articles and effectively use digital tools. Moreover, incorporating peer review activities into the learning process can significantly enhance the quality of students' writing by providing valuable feedback from their peers (Dania et al., 2023).

### 3. Characteristics of the Guidebook for Writing Scientific Articles in accordance with Student Needs

This study revealed that students require a scientific article-writing guidebook that is not only thorough but also engaging and technology-driven. Generation Z learners favor visual and digital learning tools that enable them to participate in the educational experience actively (Pašiušienė et al., 2023). Consequently, the guidebook developed should incorporate features like real-world examples, video tutorials, project-based activities, and access to a variety of digital resources.

The findings of this study reveal that students are eager for a guidebook that includes practical guidance on using scientific writing tools like Mendeley, Turnitin, and various artificial intelligence platforms. This aligns with Bates (2019), who highlighted that incorporating technology into academic learning can significantly boost both the efficiency and effectiveness of developing writing skills. Therefore, the creation of this guidebook should be grounded in the principles of need-based learning as well as technology-enhanced learning. Furthermore, it should embody the tenets of digital pedagogy, including flexibility, accessibility, and the active engagement of students in the learning journey (Batubara et al., 2023; Maknun et al., 2020).

### 4. Novelty Value and Research Implications

This research brings significant novelty by pinpointing the specific needs of students as they navigate the complexities of writing scientific articles. Unlike previous studies that tended to focus on general learning strategies or resources (Annisah et al., 2020; Desmarani et al., 2022), this study emphasizes the development of technology-driven and interactive learning materials tailored to enhance the article-writing skills of Generation Z students. The implications of these findings are far-reaching, influencing both the advancement of science and practices within higher education. Academically, the study sheds light on the challenges students face in writing scientific articles and explores how technology-based solutions can be employed to address these hurdles. Practically, the results can serve as a foundation for curriculum development, the design of academic training programs, and innovative approaches to crafting teaching materials that are more aligned with student needs.

## 5. *Limitations*

While this study offers valuable insights, it is important to acknowledge some limitations. First, the research was conducted exclusively with students from a single study program, which means the findings may not apply to students in other fields. To gain a more holistic understanding, future research should involve participants from a variety of academic disciplines. Additionally, this study relied on surveys and multiple-choice tests, which might not capture the full extent of students' writing abilities. A more thorough investigation using document analysis of students' article manuscripts could reveal common errors and challenges they encounter when writing scientific papers. Furthermore, the effectiveness of the proposed guidebook has not been thoroughly examined in this study. Future work should focus on developing and testing the digital-based guidebook and assessing its impact on enhancing students' writing skills. Given these limitations, this research paves the way for further studies aimed at uncovering more effective and innovative methods for improving students' scientific article-writing abilities.

## CONCLUSION

The study found that students possess a moderate understanding of scientific article writing techniques, but there are several areas that require improvement. Key challenges include substance writing, research methodology, the application of digital technology, citation and reference writing, and post-editing documentation. Many students struggle with crafting effective sentences and paragraphs, and they also find it difficult to grasp reference management techniques and the use of AI applications in scientific writing.

To enhance their learning experience, students expressed a desire for scientific article writing guidebooks that incorporate digital media, feature text examples, include video tutorials, utilize artificial intelligence, promote collaborative projects, offer quizzes, and provide support for developing their critical thinking and language skills.

This study suggests that the development of guidebooks and curricula for writing scientific articles should be tailored to the needs of Generation Z, who prefer interactive and technology-based content. The implication of this research is the importance of adjusting learning methods and teaching materials to improve students' scientific writing skills and overcome the difficulties faced in writing scientific articles.

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