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Evaluation of Changes in Students' Perceptions of Scientific Article Writing Skills through a Cohort Survey

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ABSTRACT

Purpose of the study: To evaluate the development of students' perceptions of their ability to write scientific articles and to identify the parts of scientific articles that are most understood and most difficult to understand by students.

Methodology: This cohort survey research was conducted by distributing questionnaires twice, namely in December 2024 and March 2025. The first survey was distributed via Microsoft Form during an online socialization event that focused on the writing of scientific articles from undergraduate theses. There were 67 students present at the event. The second survey was conducted in person during a socialization event that introduced scientific journals affiliated with the Biology Education Study Program at Faculty of Teacher Training and Education, Universitas Syiah Kuala. The event was attended by 68 students. The data obtained were subsequently analyzed using descriptive statistics.

Main Findings: There has been a positive development in students' perception of their ability to write scientific articles. In addition, this research successfully identified the parts of scientific articles that are most understood and those that are still difficult for students to comprehend.

Novelty/Originality of this study: This research uses a longitudinal survey, specifically a cohort survey, to obtain a comprehensive evaluation of the development of students' perceptions in writing scientific articles.

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1. INTRODUCTION

Writing scientific articles is an essential skill for university students [1], [2], including those in the field of biology education. The ability to write scientific papers is highly emphasized because it is related to the development of knowledge and the dissemination of research results [3]. In the Biology Education Study Program, Faculty of Teacher Training and Education, Syiah Kuala University, this skill receives special attention considering that student scientific publications have now become one of the indicators for the accreditation assessment of the study program [4]. In other words, students are encouraged to produce high-quality scientific writings as part of their academic achievements. Writing is not only an academic requirement, but it also fosters a scientific environment on campus and equips students to make a meaningful contribution to the broader scientific community [5].

Writing scientific articles brings various benefits for the academic and professional development of students [6], [7]. Through the writing process, students learn to think critically and systematically; it is even said that "writing is thinking", where the activity of scientific writing aligns with the process of critical thinking [3],

[8], [9], [10]. Writing activities force students to process ideas, search for and analyze literature, and construct arguments based on valid data and references [11]. These skills contribute to the enhancement of academic competence, such as a deeper understanding of the subject matter in their field and improved scientific communication abilities [11], [12]. As a means of practice, writing scientific articles also helps students train themselves to write correctly and improve the quality of their writing [13]. From a professional perspective, the experience of writing and publishing scientific works can enhance students' confidence, academic profile, and their future endevour [12]. This becomes a valuable asset for those who will continue their studies to a higher level or pursue a career as researchers and educators, such as in preparing action research reports in schools or other scientific publications in the future [12], [14], [15].

Although important, writing a scientific article is not an easy task for students. In reality, many students, even at the final semester, still face difficulties in academic writing and make various small mistakes [10], [15], [16], [17]. For example, errors are often found in writing bibliographies, citation techniques, or presenting tables and graphs according to the rules. This condition indicates that a strong understanding of the structure and style of scientific writing is needed. In this case, it is important for students to understand the difference between scientific articles and theses, two forms of written works they encounter in their academic journey. A thesis is a comprehensive research report that is composed in full from the introduction to the conclusion, covering the literature review, methodology, results, discussion, conclusion, and recommendations in detail. A thesis is written as a formal academic document to meet graduation requirements and is usually only accessed on a limited basis [18], [19]. On the other hand, a scientific article (such as a journal article) is a concise version of a research report that focuses on the core findings and is presented in a more compact form [18]. Although more concise, a scientific article must still include the essential elements of research like a thesis, including the background of the problem, objectives, methods, results, and discussion, as well as the bibliography, but presented in a more succinct and direct manner [20], [21]. In terms of purpose and audience, a thesis functions as an internal document for academic assessment, whereas a scientific article is intended for wide publication as a means of disseminating knowledge [18]. The differences in structure, purpose, and depth require adjustments from the students; they need to master how to condense lengthy research into a brief manuscript without losing scientific substance. It is not uncommon for students to feel less confident or confused when they first try to convert their thesis into a journal article, which indicates the need for better training and understanding of the characteristics of scientific article writing.

To see how far students' understanding and self-confidence in writing scientific articles develop, this research uses a two-stage survey approach. The two survey stages were conducted at different times (for example, before and after students gained experience or learning related to scientific writing) to evaluate changes in perception longitudinally. This kind of repeated survey approach is chosen not just to provide a snapshot but to capture the dynamics of change at the individual level over time [22], [23]. By conducting initial and follow-up surveys, researchers can observe any increase or decrease in students' perceptions of their writing abilities after undergoing a certain learning process. This two-stage strategy is beneficial in distinguishing the impact of educational experiences or interventions on students' perceptions, thereby making the evaluation results more in-depth. A similar approach is widely used in educational evaluations to measure changes in attitudes or perceptions before and after interventions [24]. In the context of scientific writing, a two-stage survey allows for the identification of parts of the writing that may initially be considered difficult by students but then become easier to understand after practice or guidance, and vice versa.

The literature review indicates that there is still a research gap regarding students' perceptions of scientific article writing, particularly longitudinal studies. Previously, several studies have highlighted the low ability or challenges faced by students in scientific writing [4], [10], [15] as well as efforts to improve writing skills through specific courses or training [10]. However, these studies generally adopt a cross-sectional approach [12], [25], case study [26]-[29], or only evaluate the final results of an intervention, thus failing to reveal the process of changing students' perceptions over time. Until now, there is still limited data on how students' perceptions develop from the initial stages of learning to write to more advanced stages and which parts of article writing (such as the abstract, introduction, methodology, discussion, or conclusion) are easiest or hardest for students to understand. By filling this gap, this research aims to contribute valuable insights that can inform the design of more effective writing instruction strategies. The urgency of this research lies in its potential to improve the teaching and learning of scientific writing, which is essential for students' academic success and their future contributions to scientific communities.

Therefore, this research was conducted to evaluate the development of students' perceptions of their ability to write scientific articles and to identify the parts of scientific articles that are most understood and most difficult to understand by students. Specifically, the objectives of this research are (1) to evaluate the changes or developments in the perceptions of students in the Biology Education Study Program at Faculty of Teacher Training and Education, Universitas Syiah Kuala, regarding their ability to write scientific articles and (2) to identify the parts of scientific articles that are perceived as most understood and most difficult by students. With the achievement of these objectives, it is hoped that the results of this research can provide valuable input for the improvement of the curriculum or teaching methods for scientific writing skills among biology education students

and simultaneously fill the gap in the literature regarding the dynamics of student perceptions in the realm of academic writing.

2. RESEARCH METHOD

2.1. Research Design and Subject

This survey research uses a longitudinal survey design. Specifically, this research falls under cohort survey research, which is a survey activity conducted on a specific group of the population to understand the development of a phenomenon over time [23], in this case, students' perceptions of scientific article writing develops through an iterative process, largely shaped by the heightened need to produce such articles as a requirement for graduation. Employing a cohort design allows for the longitudinal analysis of changes within the same individuals, offering a more cost-effective and time-efficient approach [30]-[32]. The population of this study consists of final-year students from the Biology Education Study Program at Faculty of Teacher Training and Education, Universitas Syiah Kuala, specifically those who are above the 6th semester. 67 students participated in the first survey, and 68 students participated in the second survey. The complete information regarding the population demographics is shown in Table 1.

Table 1. Demografi populasi pada survei pertama dan kedua

Demografi	First survey		Second survey	
	N	(%)	N	(%)
Gender				
Male	11	16	8	16
Female	56	84	60	88
Education level				
Undergraduate	60	90	66	97
Graduate	6	9	2	3
Other	1	1		
Semester				
2 (Graduate)			2	3
3 (Graduate)	1	1		
5 (Undergraduate)	4	6		
7 (Undergraduate)	50	75		
8 (Undergraduate)	2	3	66	97
Other	10	15		

2.2. Research Implementation Procedures

Methodologically, the current study encompasses five key stages, of which the second and forth stages involve survey administrations. Detailed information regarding the research implementation procedures is visually presented in Figure 1.

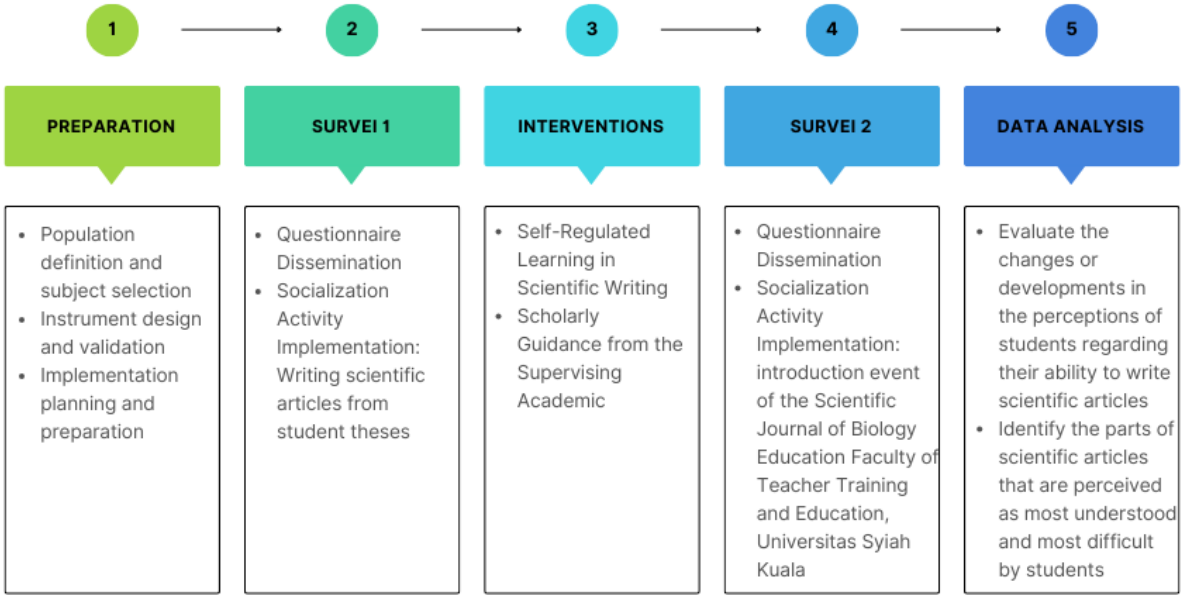

Figure 1. Research implementation procedures

2.3. Research Variables And Instruments

The variable of students' percepstions regarding scientific article writing was measured using a questionnaire based on the questionnaire indicators from Nisa et al. [29] and Cai [33]. Before use, this questionnaire was translated into Indonesian, and then its measurement indicators were adjusted. In this case, the researchers added two new indicators, namely the knowledge of creating article titles and references. Then, three experts validated the modified questionnaire. The selection of experts is based on their experience in managing the journal of the Department of Biology Education at Faculty of Teacher Training and Education, Universitas Syiah Kuala. Thereafter, the questionnaire was revised according to the input from the three validators. The final results of this questionnaire consist of eight indicators (title, abstract, introduction, methods, results, discussion, conclusion, and references) and 31 statement items with a 5-point Likert scale, where 1 means frightful and 5 means excellent. After all the suggestions from the reviewers were fulfilled, the questionnaire was distributed to the students.

2.4. Data Collection Techniques

The survey was conducted in two phases, namely the first phase in December 2024 and the second phase in March 2025. In the first survey conducted online, the questionnaire was distributed during the event for socializing the writing of scientific articles from student theses. The questionnaire was given before the material on writing scientific articles from theses began. Next, the second survey was conducted offline during the introduction event of the Scientific Journal of Biology Education Faculty of Teacher Training and Education, Universitas Syiah Kuala. As before, the questionnaire was given before the material on the introduction to student scientific journals was conducted. Both surveys were given to students in the form of a Microsoft Form link.

2.5. Data Analysis Techniques

Descriptive statistics were implemented to analyze the data that was acquired. All student responses were converted to numerical format. The students' responses were categorized into three groups in order to address the initial research question: Knowledgeable, Sufficient, and Not Knowledgeable. The Not Knowledgeable responses were calculated by adding the percentages of Frightful and Bad responses and dividing the sum by the number of statements in the indicator. The same procedure is followed for Knowledgeable; however, the sum of the percentages of Good and Excellent responses is used. Subsequently, the percentage results are presented in a bar chart. Subsequently, the second inquiry is addressed by assessing the disparities in student responses in a table. Data processing was conducted using Microsoft Excel, and subsequent data visualization was performed with the Matplotlib library in Python.

3. RESULTS AND DISCUSSION

The evaluation results regarding the development of students' perceptions of scientific article writing are presented in a clustered bar chart. This chart shows the percentage distribution in three categories, namely Not Knowledgeable, Sufficient, and Knowledgeable in two surveys, namely the First Survey and the Second Survey. The evaluation results are shown in Figure 2.

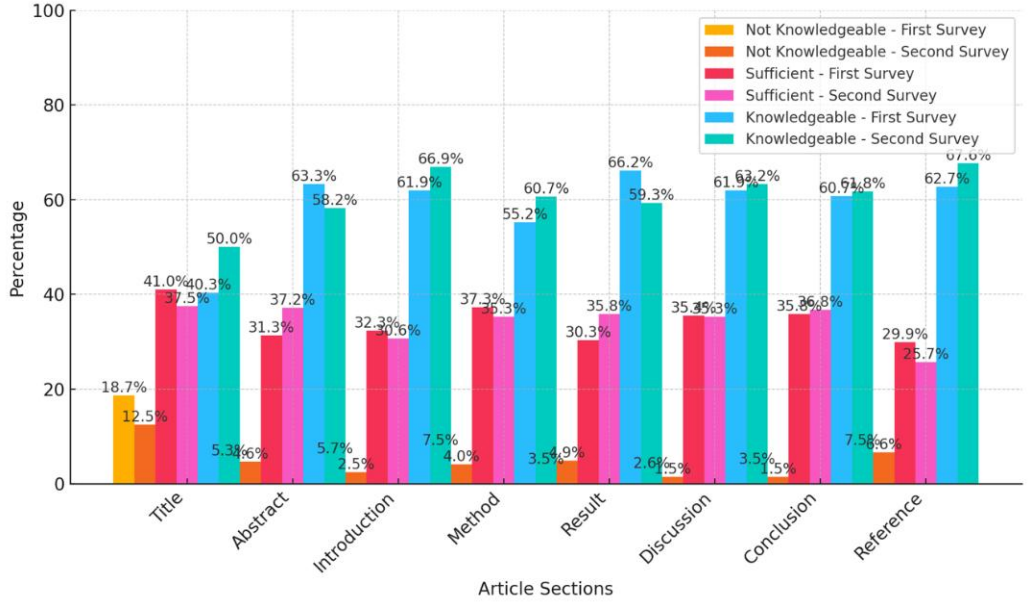

Figure 2. Comparison of the average percentage in each section of the article between the first and second surveys

Figure 2 shows several key findings that can be identified as a decrease in the "Not Knowledgeable" category in all sections of the article, indicating an increase in respondents' understanding between the two surveys. For example, in the "Title" section, the percentage of "Not Knowledgeable" decreased from 18.7% in the first survey to 12.5% in the second survey. In addition, there was a significant increase in the "Sufficient" and "Knowledgeable" categories, especially in the more complex sections of the article such as "Abstract" and "Results" in the "Sufficient" category and the "Introduction" and "Method" sections in the "Knowlegeable" category. For example, in the "Abstract" section, the percentage in the "Sufficient" category increased from 31.3% to 37.2%, and in the "Knowledgeable" category, "Introduction" increased from 61.9% to 66.9% between the first and second surveys.

The level of knowledge in each section shows different variations. In the "Title" section, the change in knowledge category is relatively small, whereas in more technical sections like "Method" and "Introduction", there is a greater increase in the "Knowledgeable" category, indicating that these sections are better understood after the second survey. For example, in the "Method" section, the percentage of "Knowledgeable" increased from 55.2% to 60.7%. Some sections, such as the "Discussion" show smaller changes, with the "Not Knowledgeable" category slightly higher than the other categories, indicating that this section might be more difficult to understand and requires further explanation ("Not Knowleageable" = -1%, "Sufficient" = 0%, and "Knowleageable" = 1%). The "Conclusion" and "Reference" sections, although showing an increase in the "Sufficient" and "Knowledgeable" categories, still have a relatively high number in the "Not Knowledgeable" category, indicating that these sections might be more difficult for most respondents to understand.

Overall, the most striking result is the consistent decrease in the "Not Knowledgeable" category and the increase in the "Sufficient" and "Knowledgeable" categories, indicating that respondents experienced an improvement in their understanding of the article between the two surveys. Time factors or interventions, such as further learning, discussions, or self-study, seem to contribute to this improvement. More complex sections, such as "Method" and "Introduction" show a greater improvement in understanding, while more abstract sections like "Discussion" and "Conclusion" show smaller changes, possibly due to difficulties in interpreting or understanding those parts in a short time. The "Method" and "Introduction" sections often present more structured information. These sections typically follow established formats that can ease comprehension and students may have a clearer pathway to grasping the content due to their systematic structure [34], [35]. According to Morgan et al. [34] structured workshops that emphasize these sections effectively enhance students' understanding and writing capabilities. Haryono and Adam [35] also emphasize that good scientific writing skills can be developed through practice and systematic instruction, hence improving students' perceptions in these areas, where clarity is paramount.

In contrast, the "Discussion" and "Conclusion" sections often require higher cognitive engagement, as they involve analyzing results, integrating these within the existing literature, and drawing broader implications, tasks that many students find challenging [36]-[38]. For instance, Wortman-Wunder and Wefes [38] highlight that doctoral students often report feeling underprepared to interpret and connect results in these abstract sections, which can limit their confidence and performance. Nisa et al. [29] note that difficulties in these segments may stem from insufficient instructional focus on critical analysis and synthesis, which are essential for comprehending discussions in scientific writings. This is supported by Kholili and Lubis [39], who discuss the importance of structuring a coherent narrative in the "Discussion" and "Conclusion", which can add complexity for novice writers. For future research, it is recommended to provide more explanations on the sections that are difficult to understand, such as the "Discussion" and "Conclusion" as well as to give feedback based on the results of the first survey to help respondents better understand the material before the second survey.

Additionally, incorporating visual strategies or examples in these sections may also help clarify any confusion or misunderstandings [25], [40]. It is important to ensure that the information presented is accessible and easily comprehensible for all participants [41], regardless of their level of expertise or background knowledge. By addressing these issues, future research can strive to improve the overall effectiveness and impact of writing scientific article.

Figure 1 only shows the students' ability to write scientific articles in general. To obtain more specific information, especially regarding which parts of the article the students are capable of or not capable of, an analysis was conducted based on each statement of the questionnaire. The results of the analysis for each statement are shown in Table 2.

Table 2. The results of the analysis of student responses regarding scientific article writing on each statement

Statements	Total		Mean		%	
	1st	2nd	1st	2nd	1st	2nd
Title						
1) Creating a title for a scientific article that aligns with the context of the paper	232	242	3,46	3,56	69%	71%
2) Crafting a title for a scientific article that is distinct from the thesis title	206	223	3,07	3,28	61%	66%
Abstract						
3) Identifying a research gap	234	231	3,49	3,40	70%	68%
4) Explaining the research methodology	248	253	3,70	3,72	74%	74%
5) Summarizing the main findings of the research	253	249	3,78	3,66	76%	73%
6) Drawing conclusions based on the research	261	250	3,90	3,68	78%	74%
7) Demonstrating the ability to communicate the urgency of the research	246	247	3,67	3,63	73%	73%
8) Using appropriate paragraph expressions in the formation of the abstract	241	239	3,60	3,51	72%	70%
9) Detailing the pressing issues that need to be addressed	238	241	3,55	3,54	71%	71%
Introduction						
10) Defining the research field	249	254	3,72	3,74	74%	75%
11) Establishing the research topic	251	257	3,75	3,78	75%	76%
12) Describing the context of the research	241	252	3,60	3,71	72%	74%
13) Applying the appropriate language aspects	248	256	3,70	3,76	74%	75%
14) Presenting a comprehensive analysis of the research gap	222	240	3,31	3,53	66%	71%
15) Formulating the research objectives	257	265	3,84	3,90	77%	78%
Method						
16) Presenting the procedures for measuring research variables	236	244	3,52	3,59	70%	72%
17) Describing the data collection procedure	242	248	3,61	3,65	72%	73%
18) Outlining the data analysis procedure	237	242	3,54	3,56	71%	71%
19) Providing a comprehensive research design	235	240	3,51	3,53	70%	71%
Result						
20) Presenting the results in accordance with the research objectives	251	248	3,75	3,65	75%	73%
21) Presenting the results using appropriate visuals, tables, or descriptive formats	251	248	3,75	3,65	75%	73%
22) Using appropriate hedging or lexical phrases (e.g., “based on”, “it should be noted that”) flexibly to structure sentences and paragraphs	247	238	3,69	3,50	74%	70%
Dicussion						
23) Providing a detailed explanation of the results or findings (elaborative)	245	242	3,66	3,56	73%	71%
24) Presenting findings or results accurately	241	252	3,60	3,71	72%	74%
25) Providing supporting references for the explanations	251	258	3,75	3,79	75%	76%
26) Clarifying the results or findings in relation to the research objectives	249	248	3,72	3,65	74%	73%
Conclussion						
27) Restating the research objectives and approach	244	249	3,64	3,66	73%	73%
28) Summarizing the findings	249	248	3,72	3,65	74%	73%
29) Presenting the contributions of the research	242	248	3,61	3,65	72%	73%
Reference						
30) Using reference management software (e.g., Mendeley or Zotero)	241	243	3,60	3,57	72%	71%
31) Using up-to-date references that meet journal requirements	256	263	3,82	3,87	76%	77%

Table 2 shows the total, mean, and percentage of student responses in the first and second surveys. Our focus in this discussion is the average (mean) of each statement that reflects aspects of scientific writing ability. The most important results from the first survey highest mean scores show that students are most sure of themselves when it comes to high-level cognitive skills. For example, they feel most sure when they “can draw conclusions from research results” in abstract (mean score: 3.90), “set research objectives” in introduction (3.84), “use up-to-date references that meet journal criteria” in reference (3.82), “summarize the main research findings”

in abstract (3.78), and "come up with research topics" in introduction (3.75). On the other hand, the aspects with the lowest mean scores in the first survey include "crafting a title for a scientific article that is distinct from the thesis title" in title (3.07) and "presenting a comprehensive analysis of the research gap" in introduction (3.31). The mean scores in Survey 2 show a relatively similar pattern, although there are slight increases or decreases in some indicators.

These results indicate that students feel more confident in high-level cognitive aspects, such as drawing conclusions, formulating research objectives, and using relevant references. This shows that their critical and conceptual thinking abilities in the context of research have advanced sufficiently, which may be a result of the project-oriented and inquiry learning approach or the research-based tasks given to them during their studies [9], [12], [41], [42]. However, there are significant gaps in the technical aspects of writing, such as "crafting a title for a scientific article that is distinct from the thesis title" and "presenting a comprehensive analysis of the research gap", where problems related to research gaps are very often experienced by students [11]. A lower mean score in this area indicates that students need additional training in the technical skills of scientific writing, which are often not explicitly taught in class. The small difference between the mean scores from the first and second survey may also reflect a change in students' perceptions of their abilities over time or after receiving certain interventions, such as training or practical writing experience [4], [17], [28], [43].

Additionally, it is possible that external factors, such as increased exposure to academic writing or feedback from peers and instructors [9], [29], [43], have influenced students' confidence in their scientific writing skills. Further research is needed to explore the reasons behind these subtle shifts in self-assessment and to determine the most effective strategies for improving students' technical writing abilities in the context of scientific research. In particular, future studies could investigate the impact of targeted interventions, such as workshops or online resources, on students' writing proficiency and confidence levels. By identifying and addressing the specific areas where students struggle the most, educators can better support their development as effective scientific communicators.

The impact of this research is significant in highlighting the positive development in students' perceptions of their ability to write scientific articles over time. By identifying the specific sections that students find most challenging, such as crafting a distinct title and presenting a comprehensive analysis of the research gap, this study provides valuable insights into the areas where targeted interventions can be implemented to improve technical writing skills. The findings also emphasize that while students have made progress in understanding the cognitive and conceptual aspects of scientific writing, there is still a need for additional training to address the technical challenges.

However, there are limitations to this research. The study relies on self-reported perceptions, which can be influenced by individual biases and may not entirely reflect the students' true abilities. Additionally, the cohort survey might limit the generalizability of the findings to other student populations or disciplines. Future research could address these limitations by incorporating a more diverse sample and utilizing objective measures of writing skills, such as analyzing the quality of written work over time. Furthermore, exploring the effectiveness of different instructional methods or interventions to target specific areas of difficulty, such as title crafting and research gap analysis, could further enhance the practical applications of the findings.

4. CONCLUSION

Based on the analysis of two conducted surveys, it can be concluded that there is a positive development in students' perception of their ability to write scientific articles. This is indicated by a significant decrease in the "Not Knowledgeable" category and an increase in the "Sufficient" and "Knowledgeable" categories in almost all sections of the article, reflecting the improvement in students' understanding over time.

In addition, this research successfully identified the parts of scientific articles that are most understood and those that are still difficult for students to comprehend. Sections such as "Drawing conclusions based on the research", "Formulating the research objectives", "Using up-to-date references that meet journal requirements", "Summarizing the main findings of the research" and "Establishing the research topic" demonstrate a high level of understanding. On the other hand, technical aspects such as "Crafting a title for a scientific article that is distinct from the thesis title" and "Presenting a comprehensive analysis of the research gap" remain a challenge for most students. These findings indicate that although cognitive and conceptual aspects have been sufficiently mastered, there is still a need to strengthen technical skills in scientific writing through more structured training or mentoring.

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