Analysis of Madrasah Ibtidaiyah Prospective Teachers' Ability to Identify Scientific Arguments in Research Articles

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ABSTRACT

Purpose – This study aims to investigate students' proficiency in analyzing scientific arguments within research papers, a critical skill for successfully composing a thesis project. Despite its importance, many students struggle to interpret scientific literature effectively as a reference source in their research. Therefore, this research evaluates students' abilities to identify various elements of scientific arguments in academic works.

Design/methods/approach – Adopting a quantitative research approach, this study utilized descriptive analysis techniques. Conducted during the even semester of the 2021/2022 academic year, the primary instrument for data collection was a rubric designed to identify scientific arguments.

Findings – The findings indicate varied proficiency levels among prospective Islamic primary teacher students in identifying different components of scientific arguments. The percentage of students accurately identifying motives was 49.3%, objectives 86%, conclusions 74.7%, implications 56%, support 10%, counterarguments 13.3%, and refutations 8%. These results highlight a significant gap, particularly in identifying support, counterarguments, and refutations, suggesting that student's ability to discern scientific arguments needs substantial improvement.

Research implications – The outcomes of this study are particularly valuable for universities in their efforts to enhance the argumentation skills of future teachers. Additionally, these findings will contribute to the development of effective learning strategies or models specifically tailored to improve the argumentation skills of prospective Islamic primary teacher students, thereby enhancing their academic and professional capabilities.

1. Introduction

The 21st century is characterized by technological advancements (Timofeev, 1996) and demands high-quality human resources in various professional fields (Brogan, 1992; Bybee & Fuchs, 2006; Dean & East, 2019; Nambiar et al., 2019). Several competencies are required to produce such quality resources (Astuti et al., 2019; Onsardi et al., 2019), which can be achieved through educational endeavors (Malik, 2018; Ramos, 2018; Tul'skaia et al., 2014). One crucial competency for prospective teachers is understanding innovative and engaging learning methodologies (Alahmad et al., 2021) through reading literature and scientific works (Dwi & Putri, 2010; Kuhlthau, 2021). Reading is an activity that builds knowledge and understanding of concepts through various literature (Pardede & Indonesia, 2019). Reading ability can foster a habit of scientific thinking as it involves thought processes supporting inquiry (Clark & Rumbold, 2006; Ness, 2022). Through reading, one can understand information by searching, analyzing, and implementing the obtained information (Sangia, 2018; Shea & Ceprano, 2017).

Individuals capable of analyzing various kinds of literature can enhance their scientific reading skills (Johnson & Martin-Hansen), critical thinking abilities, and skills in evaluating data and solving problems (Koray & Çetinkılıç, 1998). Reading articles or scientific works is a skill that must be mastered by prospective teacher students (Gazdie-Alerie, 2021) as it can improve their skills in writing research findings (Khoirunnisa, 2018), critical thinking abilities (Malamitsa et al., 2008; Priyatni & Martutik, 2020), and scientific understanding (Koray & Çetinkılıç, 1998), as well as minimize plagiarism (Rosalia & Fuad, 2019). Reading various literature is essential for prospective teacher students to understand and implement various innovative learning methodologies (Guerriero, 2014; Sudrajat et al., 2022) through research activities (Saefuddin et al., 2019). However, many students still struggle to interpret scientific literature as a reference source in their research activities (Nirwana & Ruspa, 2020; Septafi, 2021; Widodo et al., 2020). According to Healey et al. (2014), preparing students in their first year can assist senior students in implementing their research (Healey et al., 2014).

In equipping students for their research activities, it is necessary to introduce them to scientific articles resulting from research. Through reading, students are accustomed to analyzing (Priyatni & Martutik, 2020) and identifying the structure of scientific articles resulting from research (E. et al. et al., 2014). According to Van Lacum et al. (2014), reading analysis results of articles can aid in understanding the scientific argumentation of researchers (E. et al. et al., 2014). Scientific argument identification can be conducted using the Scientific Argumentation Model (SAM). Previous research has shown that the SAM model can identify students' abilities in article identification, such as the scope of research problems, research objectives, research conclusions, consequences of identifying research recommendations, applications of research findings, suggestions for further research, literature supporting research findings, and factors that can weaken the conclusions of the research (Agnesa & Anggrella, 2022; Rahmasiwi, 2020; E. et al. et al., 2014). Based on the importance of equipping students to write research findings, it is necessary to identify scientific arguments in scientific articles among prospective teacher students. This study's results can illustrate students' ability to identify scientific arguments and be used as a reference in developing the ability to analyze articles as a basis for student research activities.

2. Methods

Prospective teacher students of the Madrasah Ibtidaiyah (MI) program at UIN Raden Mas Said served as subjects in this study, totaling 151 students from the 2019 cohort. This research adopted a descriptive quantitative approach and was conducted in 2021. The research design was a survey aimed at analyzing the profile of students' abilities to identify scientific arguments through reading articles. The instrument for identifying scientific arguments was developed by Lacum (2014) and has been tested for validity and reliability. The articles identified by the students were research findings by Saefi (2017), published and indexed in SINTA (Saefi et al., 2017). The aspects analyzed to understand the identification of scientific arguments through the students' article-reading activities used the Scientific Argumentation Model (SAM) as follows:

Table 1. Aspects of the Scientific Argumentation Model (SAM)

No.	Aspect	Definition
1.	Motive	Statements indicating why the research was conducted or can be considered as the scope of the research problem. Examples: gaps in knowledge, conflicting results, etc.
2.	Objective	Statements indicating what the researcher wants to know. Objectives can be formulated as research questions, purposes, or hypotheses to be tested.
3.	Conclusion	Statements about the main results obtained from the research. Conclusions are closely related to the objective, as the conclusion answers the research purpose.
4.	Implication	Statements indicating the consequences of the research. Example: can be formulated regarding recommendations, applications of the conducted research (e.g., a theory is produced), or proposals or suggestions for future research.
5.	Support	Statements used by researchers to strengthen the conclusion. Support in research articles can be in the form of research data results or data interpretation and in the form of references or other literature that supports it.
6.	Counterargument	Statements that weaken the conclusions obtained or can be formulated in terms of factors that weaken the results. For example, the research method has many shortcomings, such as data anomalies, results contradicting previous research, etc.
7.	Refutation	Statements that can weaken or refute counterarguments.

Source: (E. et al., 2014)

3. Results and Discussion

Scientific argument identification is analyzing researchers' arguments related to their research findings. Identifying scientific arguments can build new understandings of researchers' arguments. As prospective researchers, students must understand the argumentation from research results to use it as a theory/reference in writing their scientific work by reading various literature articles. Students must grasp the researchers' thought processes, such as data interpretation, article writing, and critically analyzing research outcomes (Coil et al., 2010).

The test results for identifying the scientific argumentation abilities of prospective teacher students are briefly shown in Table 2.

Table 2. Data on Test Results for Identifying the Scientific Argument Ability of Prospective Teacher Students

SAM Aspect	Answer (%)		
	Correct	Semicorrect	Incorrect
Motive	49.3	34.7	16
Objective	86	6	8
Conclusion	74.7	13.3	12
Implication	56	6.7	37.3
Support	10	0	90
Counterargument	13.3	6.7	80
Refutation	8	5.3	86.7

Based on the analysis results in Table 2, the level of identification of students' scientific arguments tends to be low in most of the components. This statement can be seen from the number of wrong answers scored more than the correct answers. Next, we collected data on the answers of prospective teacher students who were correct in every aspect, as shown in Figure 1.
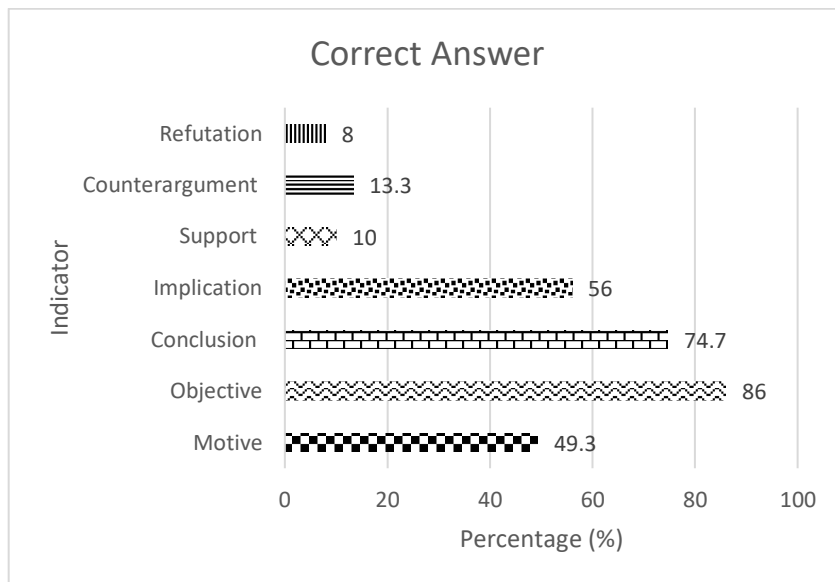
Figure 1. Correct Answers of Prospective Teacher Students in Each Aspect

Based on Figure 1, the number of correct answers to aspects of scientific argument identified by students from the most to the least is objective, conclusion, implication, motive, counterargument, support, and refutation. We describe the students' answers on each aspect shown in Figures 2 to 8.
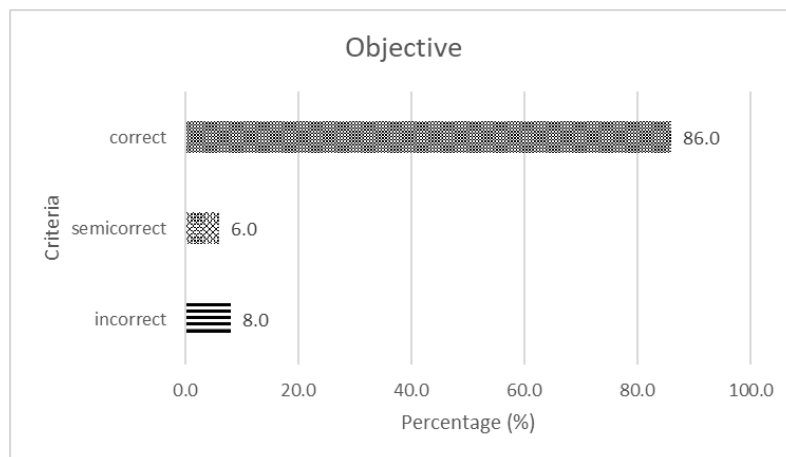

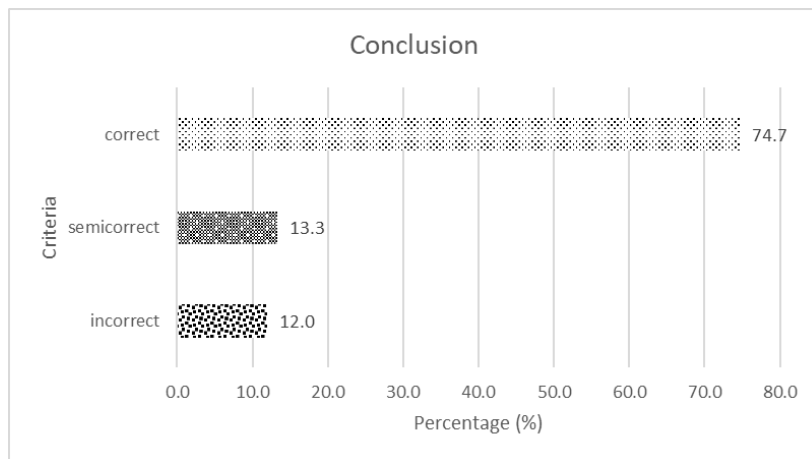**Figure 2. Answers of Prospective Teacher Students on Objective Aspects**

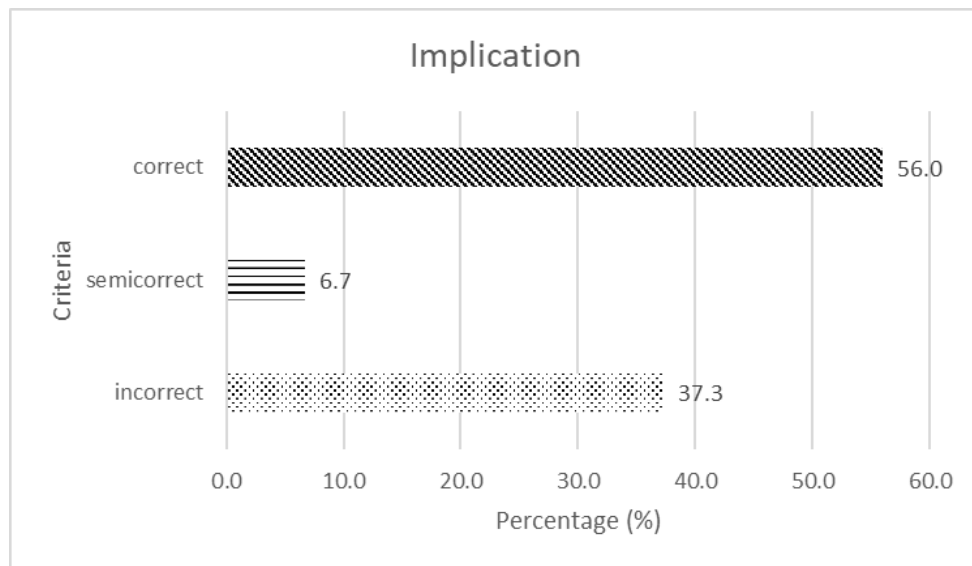**Figure 3. Student-Teacher Answers on the Conclusion Aspect**

Figure 4. Answers of Prospective Teacher Students on the Implication Aspect
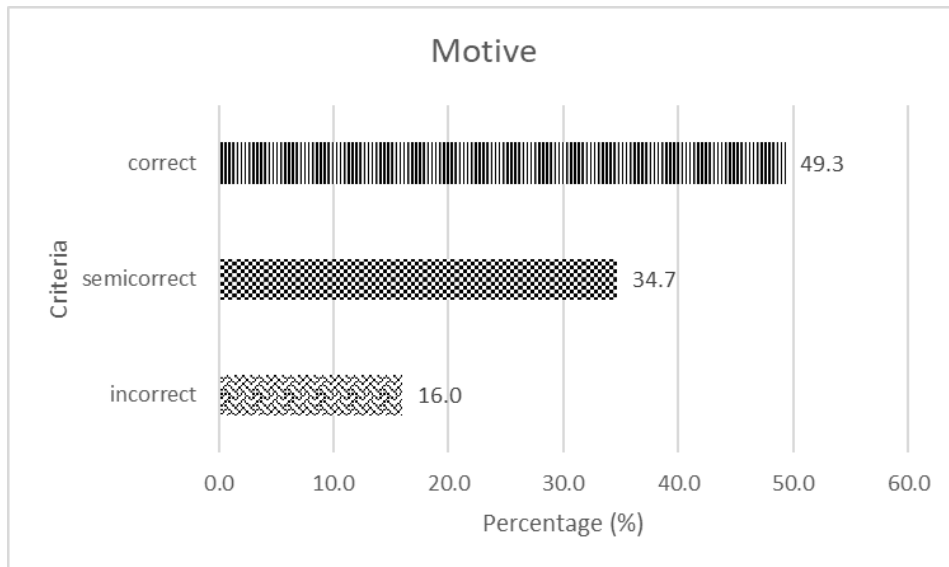
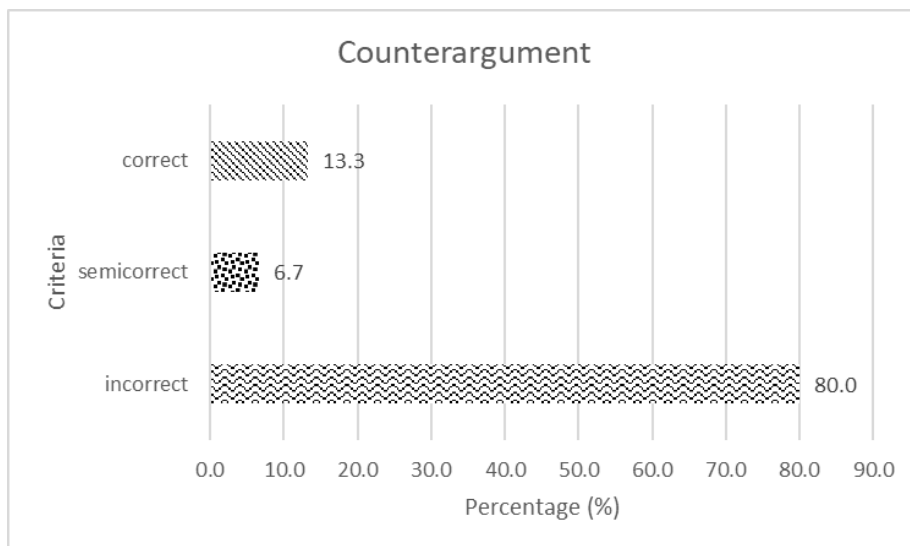**Figure 5. Answers of Prospective Teacher Students on the Motive Aspect**

Figure 6. Answers of prospective teacher students on the counterargument aspect
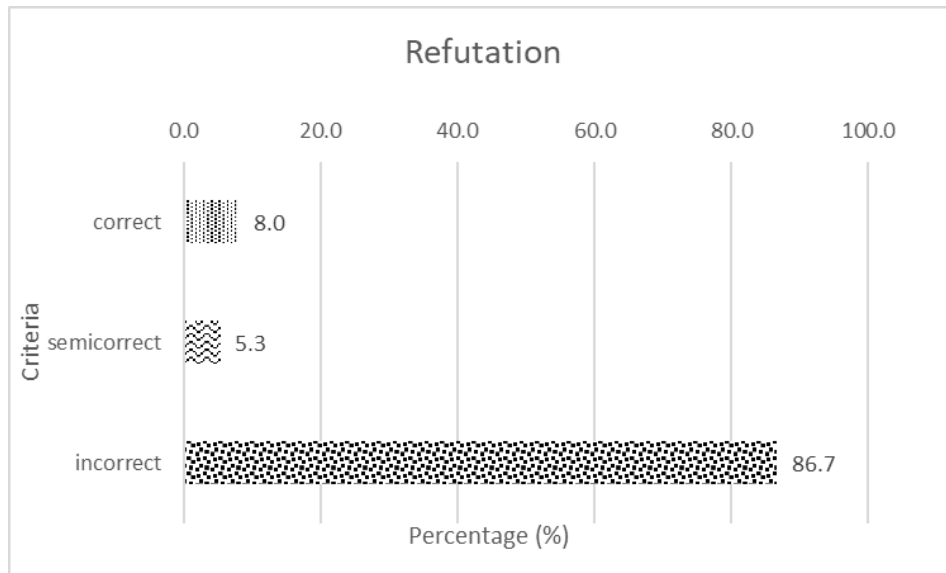
Figure 7. Answers of prospective teacher students on the Refutation Aspect
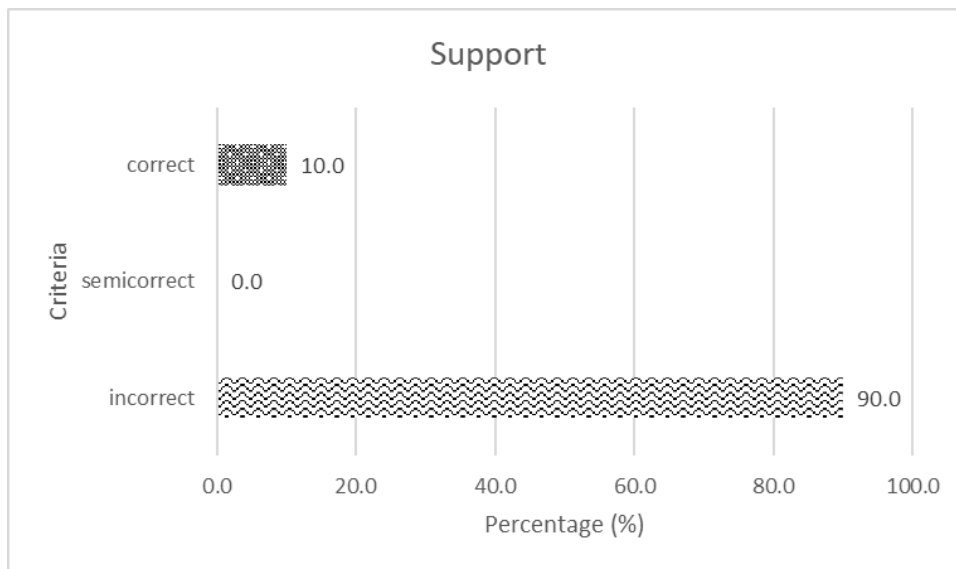
Figure 8. Answers of prospective teacher students on the support aspect

86% of the students correctly identified the objective aspect, with 6% providing semi-correct answers and 8% incorrect. The conclusion aspect, which states the main findings of the research or answers from the research, shows 74.7% of students answering correctly, 13.3% semi-correct, and 12% incorrectly. The objective aspect relates to what the researcher wants to know, while the conclusion is linked to whether or not the research objectives were achieved. These two aspects are easier for students to identify as they are usually stated directly in the article, making them easy to find or identify (Agnesa & Anggrella, 2022; Lammers et al., 2019; Rahmasiwi, 2020; E. et al. et al., 2014).

Additionally, the implication aspect, which is the researcher's statement showing the consequences of the research formulated in the form of recommendations or suggestions for future research, was correctly identified by 56% of students, with 6.7% semi-correct and 37.3% incorrect. Typically, the implication aspect is found in the suggestions section or at the end of discussions, making it easily identifiable by students. However, according to research (Rahmasiwi, 2020), the implication aspect is one of the aspects that students find difficult to understand because, in some articles, the implication is not explicitly explained in the introduction or discussion, making it challenging for students to find.

The next aspect, motive, relates to the scope of the research problem or the reason for conducting the research (E. et al. et al., 2014). According to E. van Lacum et al. (2016), the motive aspect is closely related to the objective, as research objectives are formulated based on the motive. From the analysis of the motive aspect, 49.3% of students identified it correctly, 34.7% semicorrect, and 16% incorrectly. The motive aspect concerning why the research is important is usually found in the introduction of scientific articles, making it easily identifiable by students. However, the results of the analysis show that 34.7% of students identified it semicorrectly. This aligns with research (Agnesa & Anggrella, 2022), indicating that the motive aspect is one of the hardest for students to identify, possibly due to their lack of understanding of research problems and low reading literacy (Syazali et al., 2020).

Aspects of scientific argumentation that students find difficult include counterargument, support, and refutation. The low performance in these aspects is due to the high number of incorrect answers. Typically, articles in Indonesia do not contain counterarguments or refutation aspects. The counterargument is an argument that weakens the conclusion (E. van Lacum et al., 2016). This is evidenced by analysis results showing that only 13.3% of students correctly identified the counterargument, 6.7% semicorrectly, and 80% incorrectly. The low identification of counterarguments in articles aligns with research (Agnesa & Anggrella, 2022; Ahmed, 2015; Tauhidah et al., 2018; E. et al. et al., 2014), possibly due to their scattered presence in the discussion sections, and also due to students' low literacy abilities (Syazali et al., 2020). Unlike the conclusion aspect, which is found at the end of the discussion and has distinctive lexical features, making it easy to identify, counterarguments do not have such features. Another reason for students' inability to identify counterarguments is their habit of reading textbooks (Gillen, 2006). Textbook readings rarely contain counterarguments, as they tend to present knowledge claims without explaining how they emerged (Goldman & Bisanz, 2014), leading to students' lack of experience in identifying counterarguments (E. et al. et al., 2014).

Identification of the counterargument aspect is related to identifying the refutation aspect. Analysis results show that only 8% of students answered correctly, 5.3% semicorrectly, and 86.7% incorrectly. The low performance in the refutation aspect is because refutation is a statement that can weaken the counterargument (E. van Lacum et al., 2016), so if students struggle with identifying the counterargument, it also impacts their ability to identify refutation (Agnesa & Anggrella, 2022; Rahmasiwi, 2020).

The low identification of counterarguments and refutation is due to the tendency of articles written by researchers to support their research findings (support) (Tauhidah et al., 2018). However, according to the survey, students' ability to identify the support aspect is also low, with only 10% answering correctly and 90% incorrectly. The support aspect is a statement to justify the conclusion (E. van Lacum et al., 2016). The low performance in the support aspect can be attributed to the lack of distinct characteristics like the conclusion aspect (E. et al. et al., 2014) and its scattered presence in the discussion section, making it difficult for students to identify (Syazali et al., 2020).

The low ability to identify scientific argumentation aspects like counterargument, support, and refutation indicates that students struggle with understanding the language in scientific articles (Fang,

2005). According to Gillen (2006), the low ability to analyze scientific articles is because research articles use terms that are not easily understood, making it difficult for students to comprehend the arguments of researchers interpreted in the research findings. Every research article contains informative aspects, such as research methods, interpretation of results, and critical analysis of research findings, presented using various writing genres. The writing genre of articles is organized based on specific communicative functions (rhetorical moves). Therefore, a solution to improve students' ability to identify scientific argumentation can be pursued through learning activities that can empower article analysis skills, thereby assisting students in identifying researchers' argumentation (Yarden et al., 2015). The SAM model is a choice to optimize the identification of scientific arguments (Lammers et al., 2019). Scientific argumentation competence can also be developed through a scientific reading-based Inquiry (Probosari et al., 2019). Additionally, research shows that the Consider, Read, Elucidate hypotheses, Analyze and interpret data, Think of the next Experiment (CREAT) method can enhance reading and analyzing literature competencies (Hoskins et al., 2011; Hoskins & Gottesman, 2018; Krufka et al., 2020).

4. Conclusion

This study systematically categorizes the components of students' scientific argumentation, highlighting a progression from objectives and conclusions to implications, motives, counterarguments, support, and refutation. The scientific argument identification survey outcomes emphasize the need for additional investigation into effective learning methodologies. Such methodologies should aim to bolster the capabilities of article analysts in discerning the nuances of scientific arguments, with a particular focus on elements like counterarguments, support, refutation, and motives. Enhancing the ability to identify and interpret these aspects is expected to substantially improve students' competencies in composing scientific papers and conducting research, thereby elevating the quality of academic scholarship.

The findings of this study have practical implications for educational institutions, particularly universities that are preparing future educators. They provide a framework that can be utilized to refine and advance the argumentation skills of teacher trainees. Specifically, in Islamic primary teacher education, these results are instrumental in guiding the development of tailored learning strategies or models. Such strategies are aimed at enhancing the argumentation capabilities of students, thereby equipping future educators with essential skills for effective teaching and academic discourse. This advancement in argumentation skills benefits the individual students and contributes to the broader educational landscape by promoting higher standards of reasoning and debate in academic settings.

Declarations

Author contribution statement

Suprapti conceived the presented idea. Dita Purwinda Anggrella and Ahmad Kamal Sudrajat was data taker. All authors performed data analysis. All authors discussed the results and contributed to the final manuscript.

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Data availability statement

The datasets generated during and analyzed during the current study are available from the corresponding author upon reasonable request.

Declaration of Interest's statement

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

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