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Profile of Argumentation of Grade 10th Students in Socioscientific Issues on Viruses Concept

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Abstract

This study aims to determine the argumentation skills of grade 10th students towards socio-scientific issues at one of the senior high schools in Cileungsi, Bogor. This study was conducted using test and documentation techniques. The research method used is quantitative descriptive. Sampling was carried out using a purposive sampling technique; there are 128 students from 4 classes. The instruments used in this study were 5 standpoint questions related to the phenomenon of the spread of monkey pox and the test scores for virus material. The results of the study revealed that the quality of the written argumentation skills of class X students was mostly at levels 2 and 3, with an average percentage of 30.30% and 45.62% respectively. The findings imply that students are still in the process of developing higher-order thinking and scientific reasoning skills when engaging with socio-scientific issues. Therefore, science educators are encouraged to incorporate explicit argumentation-based learning strategies to promote deeper analysis, evidence-based reasoning, and the ability to construct coherent scientific arguments in response to real-world problems.

Keywords: Argumentation Skills, Socioscientific Issues, Viruses

INTRODUCTION

Indonesia is classified as a developing country, facing numerous challenges in areas such as employment, daily life, and especially in preparing the younger generation's education. According to González-Pérez & Ramírez-Montoya (2022) the challenges students encounter today include globalization, 21st-century skills, the Fourth Industrial Revolution (Industry 4.0), and education in the post-COVID-19 pandemic era. This situation demands competitiveness in many areas, particularly in the quality of human resources (HR). Indonesia requires resilient, intelligent, and character-driven human resources. Improving HR quality is closely tied to the national education system. According to González-Pérez & Ramírez-Montoya (2022), the 21st-century skills that must be mastered and developed include: (1) critical thinking and problem solving, (2) communication and collaboration, (3) creativity and innovation, and (4) digital literacy skills. Based on this, communication is an essential component of education that must be mastered and continuously developed.

Communication is a crucial component of education, as educational goals can only be achieved when the process is communicative, meaning there is two-way communication. This aligns with Agustina & Sitompul (2015) view on communication in biology education, stating that learning is a deliberate, purposeful, and goal-oriented effort, aimed at enabling others to gain meaningful experiences. Biology learning refers to an interactive process between

teachers, students, and learning resources. Another perspective on the importance of communication in biology education is offered by Urwani et al. (2018), who argue that communication skills are essential for interacting with others and the environment in biology education. In science education, the term "process skills" is often encountered. According to Mayani et al. (2023), science process skills related to scientific communication abilities include reading and gathering information from graphs or diagrams, plotting empirical data, organizing and presenting reports systematically, and explaining experimental results.

One of the communication practices that can be performed by students is through argumentation. Argumentation serves as a fundamental platform for students to practice communication and interaction in the science learning process. According to Wulansari et al. (2020), argumentation skills require individuals to express their opinions, both in written and spoken forms. Argumentation abilities are crucial for students, as they help them present rational arguments, allowing their perspectives to be accepted by others. Herlanti et al. (2012) state that science or biology learning is not merely about discovering and presenting facts, but also about constructing and evaluating arguments, as well as discussing various explanations of phenomena. This view emphasizes that argumentation is used to support theories, models, and explain natural facts. This highlights the importance of argumentation skills in biology education. However, in practice, previous research has indicated that students' argumentation skills are still significantly low. On average, high school students' argumentation skills are at level 1 or level 2, with very few students reaching level 3.

Research by Agoestanto et al. (2019) suggests that students with low curiosity levels tend to have equally low argumentation skills or problem-solving abilities in connecting available information. This indicates a potential relationship between students' curiosity during argumentation activities and their argumentation skills. Curiosity is influenced by how engaging the activities are during the learning process. Utilizing interesting topics can help stimulate students' interest and curiosity, particularly in argumentation activities during learning.

Discussing socio-scientific issues can be an effective approach to facilitate the development of students' argumentation skills, as well as help them better understand scientific concepts. According to Mediyanti et al. (2025), Socio-Scientific Issues (SSI) are contemporary issues that involve the interaction between science and society, often with significant social and environmental impacts. Examples of socio-scientific issues include climate change, biodiversity, energy use, public health, and technology. In the context of socio-scientific issues, students argue from their perspectives or areas of interest, leading to arguments that extend

beyond scientific knowledge to include ethics and values. This demonstrates that using socio-scientific issues is effective in enhancing students' argumentation skills, both orally and in writing.

One of the learning outcomes for the concept of viruses in biology is for students to identify the role of viruses and propose solutions to prevent their spread. Using argumentation by discussing socio-scientific issues in the context of virus concepts is considered effective for meeting CP requirements. This approach allows students to express their opinions or present arguments to solve a problem or propose solutions for a phenomenon or issue currently affecting their surroundings. To achieve these CP demands, written argumentation activities based on Dawson & Venville's (2013) theory, supported by discussions of socio-scientific issues, can be implemented.

In line with Saparudin's (2022) previous statement, a recent issue circulating in society related to viruses is the spread of monkeypox in several countries, which has also reached various regions in Indonesia. Therefore, this topic is appropriate for discussion in this research. According to current news, the monkeypox virus has spread to several regions, including West Java. This prompted the researcher to focus on a school in West Java, specifically at one of the senior high schools in Cileungsi, Bogor, as the object of this study. Another reason for selecting this school is the diverse social background of its students, ranging from upper to lower socioeconomic levels. One of the senior high schools in Cileungsi, Bogor, is located in an urban periphery area, attracting people from various regions, resulting in a variety of ethnic and cultural backgrounds. This diversity is expected to provide a wide range of argumentative responses.

METHOD

This research was conducted at one of the senior high schools in Cileungsi, Bogor, during the even semester of the 2023/2024 academic year. The research method used is descriptive quantitative. This study aims to systematically and accurately describe the observed, obtained, and experienced situations or events. Data processing in descriptive quantitative research is based on percentage analysis and trend analysis, with the collected data being descriptive in nature. Therefore, the study does not aim to provide explanations, test hypotheses, make predictions, or explore implications. The results of the quantitative data analysis are derived from supporting data, such as students' argumentation scores.

The sample in this study consists of the tenth-grade classes from one of the senior high schools in Cileungsi, Bogor. The subject selection technique used in this research is purposive

sampling, which is a method of determining samples based on specific considerations or special selection criteria set by the researcher. The data collection techniques employed in this study include tests and documentation. The argumentation skills assessment aims to gather responses and arguments from students regarding the socio-scientific issue of monkeypox. Data collection was conducted by distributing the assessment through a Google Form link to the selected tenth-grade students using the purposive sampling method, specifically classes X.3, X.7, X.8, and X.9.

The guidelines for determining the levels of argumentation components include a rubric outlining the levels of written argumentation components based on the Dawson & Venville (2013) analysis framework, as modified by Herlanti (2016). This framework consists of five components: claim, data, warrant, backing, and qualifier/reservation, and encompasses five levels, like in Table 1.

Table 1. Analysis Framework for Assessing Written Arguments Modified by Herlanti (2016), Based on Dawson & Venville (2013)

Level	Description
1	The discourse contains a Claim (K).
2	The discourse contains a Claim and Data (DK).
3	The discourse contains a Claim, Data, and Warrant without Backing (DKW).
4	The discourse contains claims, data, warrants, along with backing, but lacks qualifiers and/or rebuttals (CDWB).
5	The discourse contains claims, data, warrants with backing, and qualifiers and/or reservation exceptions [Reservation] (DKWBQR)

The number of student arguments for each level of argumentation is calculated in a percentage using the formula proposed by Purwanto (2013), adopted from Tanfiziyah & Rochintaniawati (2021), as follows:

$$NP = \frac{R}{SM} x\ 100\%$$

NP: The desired or expected Percentage Value; R: The number of arguments that appear at the specified level SM: The total number of student arguments in the specified class.

RESULTS AND DISCUSSION

The research findings in this study consist of data from 10th-grade students at SMA Negeri 1 Cileungsi, obtained through the completion of argumentation skill questions regarding the socioscientific issue of monkeypox. The argumentation skill questions given to the students consist of five questions, each addressing the phenomenon of monkeypox virus transmission, particularly focusing on the topic of its spread in Indonesia. The percentage results of the students' argumentation levels can be seen in Table 2.

Table 2. Overall Percentage of Students' Argumentation Levels

Student Argumentation Levels	Percentage of Students' Argumentation Skills
1	9,06%
2	30,30%
3	45,62%
4	11,05%
5	3,75%

Based on Table 2, it can be observed that the highest average argumentation level is level 3, with 45.62%, followed by level 2, with 30.30%. These values were obtained from a total of 128 students across four 10th-grade classes. The lowest percentages are found at level 1, with 9.06%, and level 5, with 3.75%. From the five questions given, some students were able to answer each question at level 5, with the highest average percentage for level 5 being on the second question, at 7.03%. Below is a diagram showing the overall percentage of students' argumentation levels.

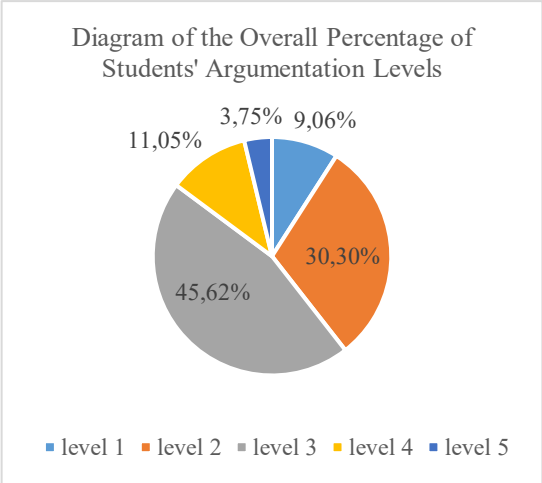

Figure 1. Overall Percentage of Students' Argumentation Levels

Based on Figure 1, it can be seen that the average argumentation level across all 10th-grade classes is predominantly at level 3, with 45.62%, followed by level 2 at 30.30%. The average argumentation levels with the least representation among the 10th-grade classes are level 5 at 3.75% and level 1 at 9.06%. Overall, from the five questions provided, some students were able to respond at level 5. A detailed breakdown of the argumentation levels of the 10th-grade students for each question can be found in Table 3.

Table 3. Calculation of Percentage of Argumentation Level for Each Question

Level	Argumentation Percentage					Total
	Question 1	Question 2	Question 3	Question 4	Question 5	
1	6,25%	10,15%	10,15%	9,37%	9,37%	9,06%
2	38,28%	29,68%	21,87%	32,03%	29,68%	30,30%
3	50,78%	46,09%	39,05%	50%	42,18%	45,62%
4	2,34%	7,03%	26,35%	4,68%	14,84%	11,05%

5	2,34%	7,03%	1,56%	3,90%	3,90%	3,75%

Table 3 shows that 11.05% of students were able to answer all five argumentation skill questions at level 4. This indicates that a small proportion of students can provide backing for the warrants presented in an argument. The backing referred to in the context of the students' responses consists of sources or references they possess to strengthen the given warrants. This is indicated by the presence of phrases such as "based on," "according to the data," and "from my experience." This suggests that some students are already able to connect the information they have received or possess to support the claims they make.

Table 3 also shows that, on average, students were able to answer the questions at level 5, although only 3.75% of the total were able to achieve this level. This indicates that a small proportion of students can express their opinions or claims supported by data, warrants, backing, and/or qualifiers, and/or rebuttals. At the quality of argumentation level 5, not all components are necessarily present in the arguments provided by the students. Some arguments include Claims, Data, Warrants, Backing, and Rebuttals [DKWBR], while others include Claims, Data, Warrants, Backing, and Qualifiers [DKWBQ] (Herlanti et al., 2012).

This is related to the types of questions given. The Rebuttal component is more frequently found in questions two and four compared to the Qualifier component, as in question two, the majority of claims made are conditional, meaning that the claims are adjusted to specific conditions. This is indicated by the presence of words or phrases that counter the claims made, such as "but," "however, I disagree if," or "I do not agree, but it is acceptable if." The Rebuttal in question four emphasizes the uncertainty of the provided answers, leading to a rebuttal of the previously made claims. This is marked by phrases like "I do not agree..., but this is not impossible," and "I do not agree..., but this could happen." The Qualifier components in the arguments provided by the students are generally accurate in relation to the questions posed. The Qualifier component is typically indicated by words or phrases such as "must" and "very."

Level 1 is still observed in the students' arguments, with an average percentage of 9.06%. This indicates that students are only capable of providing simple claims of agreement or disagreement, or merely stating claims and counterclaims without accompanying data, warrants, backing, and/or qualifiers, and/or rebuttals. The average percentage of argumentation skill at level 1 is relatively low compared to the average percentage at level 4. This suggests that some students are already able to present their arguments backed by reasoning, investigation, or by gathering facts from the discussed topic. This is certainly in line with Herlanti et al. (2012), which states that the role of argumentation in science education is fulfilled when science is presented as a body of knowledge that is tested or verified through a process

of establishing its truth via reasoning, conjecture, evidence evaluation, and consideration of counterarguments.

The details of students' argumentation skills on each question indicate that none of the students in class X.7 were at level 1, meaning the percentage of level 1 in each question for class X.7 is 0%. This demonstrates that students in class X.7 are already capable of providing data or justification straightforwardly. In contrast, class X.9 has the highest number of students at level 1 compared to other classes. The students at level 1 in class X.9 predominantly answered with claims on all questions without providing supporting reasons for their claims. This may be attributed to several factors, one of which is low curiosity. This is explained by Agoestanto et al. (2019) in their research, which states that students with low levels of curiosity have a direct correlation with their argumentation skills or their ability to solve problems by connecting available information.

Additionally, other results indicate that the majority of students with fairly good argumentation levels, such as levels 3, 4, and 5, are from class X.8. This suggests that students in class X.8 are capable of providing responses and justifications for their claims, as well as connecting available information to solve problems. The emergence of higher levels in class X.8 may be attributed to several factors, one of which, as discussed earlier, is that a high level of curiosity correlates with students' argumentation skills. However, when examining the scores related to the virus material, this does not appear to be relevant. The average score for the virus material across all four classes is 80, indicating that there is not much influence of the conceptual understanding of viruses on students' argumentation skills.

Based on Figure 1, it was found that 10th-grade students at one of the senior high schools in Cileungsi, Bogor are predominantly at levels 2 and 3, with only a few reaching levels 4 and 5. The responses provided by students are mostly simple answers that do not adequately connect with the information presented or provide concrete evidence. This indicates that many students still struggle to reason through complex problems and have difficulty connecting existing information to answer the questions posed. This aligns with Indonesia's educational ranking according to TIMSS 2015, where the country ranked 44th out of 49 participating countries. Indonesian students are at a lower level, only reaching up to level 3, while many students in other developed and developing countries achieve levels 5 and even 6. Additionally, PISA results indicate that Indonesia ranked 67th out of 203 countries in 2023. This outcome suggests that Indonesian students lack familiarity with high-level questions that require application and reasoning skills.

Based on the research findings, the argumentation skills of students at one of the senior high schools in Cileungsi, Bogor, need to be continuously developed to improve the quality of these skills. One effective practice to enhance argumentation skills is to encourage students to regularly respond to answers provided by others during learning, whether in written or verbal form. This approach helps make the material learned more meaningful for students.

CONCLUSION

The conclusion of this study indicates that the average level of students' written argumentation skills in 10th grade regarding the socioscientific issue of monkeypox, based on the Dawson & Venville (2013) analytical framework, predominantly falls at level 3, with a percentage of 45.62%. Students at one of the senior high schools in Cileungsi, Bogor, are able to reach level 5 in argumentation skills, albeit with a lower percentage of 3.75%. Additionally, 11.05% of students are at level 4, which is higher than the 9.06% who are at level 1. The results of this study also show that students are able to present claims, accompanied by warrants and evidence, although the evidence is still relatively simple. A small proportion of students are capable of providing backing, and/or qualifiers, and/or rebuttals to strengthen the claims, data, and warrants presented. The findings imply that students are still in the process of developing higher-order thinking and scientific reasoning skills when engaging with socio-scientific issues. Therefore, science educators are encouraged to incorporate explicit argumentation-based learning strategies to promote deeper analysis, evidence-based reasoning, and the ability to construct coherent scientific arguments in response to real-world problems.

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