

Profile of High School Students' Arguments on Environmental Pollution Materials in the Covid-19 Era

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ABSTRACT

The study aims to identify the argumentation profile of high school students in learning in the covid-19 era. This research is quantitative descriptive with a survey method. The research population was 172 students, with a sample of 72 students. Determination of the sample using cluster random sampling technique has a balanced quality from the results of the paired F test. The research procedure was carried out by collecting data on student answers from argumentative essay questions distributed via a google form. Argumentative questions based on TAP contain six components, namely Evidence (E), Warrant (W), Backing (B), Qualifier (Q), Rebuttal (R), and Claim (C). The argumentation scoring rubric is calculated based on the Patton-Pickle rule. Data analysis was carried out by interpreting the scores obtained by students on each argumentation component that showed the argumentation profile. Most of the students' argumentation profiles, according to their components, are in the very low category scores, namely 0.5 and 1. A score of 0.5 is obtained by comparing the percentages of students: E: E: W: W: B: Q: R: C: C: C by 23.61%: 1.39%: 0.00%: 52.78%: 45.83%: 83.33 %: 4.17%: 2.78%: 2.78%: 0.00% while the score of 1 is 41.67%: 55.56%: 83.33%: 47.22%: 54.17%: 8.33%: 75.00%: 83.33%: 79.17%: 98 ,61%. Scores were obtained due to various factors, including the learning process that was less meaningful, students' understanding and reasoning of the material was not in-depth, the generalization process of evidence or theory was not appropriate.

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1. INTRODUCTION

The main target of 21st-century learning is that students can build high-level thinking skills (Heong et al., 2012; Richland & Simms, 2015; Yen & Halili, 2015). One of the high-level thinking skills is argumentation which is the main competency target in learning (Kuhn, 2010). Argumentation is one of the bases for forming reasoning skills that are useful in the problem-solving process (Kristianti et al., 2018; Özgelen, 2012). Argumentation is a form of reasoning activity to provide reasons for changes so that others believe in the changes submitted based on evidence and other supporting sources (Cebrián-Robles et al., 2018). Argumentation in learning contributes to encouraging cognitive processes, metacognitive, communication skills, critical thinking, the development of reasoning, and the determination of students' attitudes towards something (Erduran & Jiménez-Aleixandre, 2007). Argumentation ability is in line with students' conceptual understanding (Viyanti et al., 2016). The better the understanding of students' concepts, the better the quality of the arguments presented (Aydeniz et al., 2012) so argumentation can be one of the alternative assessments. Argumentation as an alternative assessment is useful for measuring high-level thinking skills that can be analyzed structurally based on their components (Clark & Sampson, 2008; Toulmin, 2003).

Structurally argumentation contains at least three main components, namely claim (statement), warrant (justification), and evidence (Hitchcock, 2005; Karbach, 1987)). According to Toulmin S. E (2003) the components of argumentation include evidence, claim (statement), warrant (justification), backing (support), a qualifier (limit statement), and rebuttal. Argumentation interventions or training are focused on various strategies, such as learning materials (Berland & Reiser, 2009; McNeill et al., 2006). Materials on biology learning that can accommodate students' arguments well, one of which is environmental pollution (Kemendikbud, 2018; Sadler et al., 2007). Environmental pollution is one of the social issues that often occur in the surrounding environment (socioscientific issue) (Nurtamara et al., 2019; Tidemand & Nielsen, 2017). Problems or phenomena that often occur in the surrounding environment (socioscientific issues) make students easier and optimal in identifying facts as evidence to strengthen statements (claims) related to the phenomenon conveyed (Sadler et al., 2007).

The claim is a statement, idea, opinion, or hypothesis about a phenomenon that is submitted to the public (Toulmin, 2003). The construction of claims is debated and justified using evidence, logic, warrant, and reasoning (Driver et al., 2000). Claims are the easiest component to express. A good claim consists of a network of propositions that indicate the relative coherence of the explanation presented (Brown et al., 2010). Claims must be based on evidence to be scientifically proven and accurate (Sandoval & Millwood, 2005). Evidence is a specific fact or data used to support the submitted claim (Toulmin, 2003). Evidence obtained by students in arguing is equipped with other sources that support it (Archila, 2017) so that the statements or opinions expressed by students in discussing are more readily accepted scientifically. Acceptance of opinions scientifically means received logically and rationally by the mind with the relationship between opinions or claims with the evidence presented and built in the argumentation component (Faize et al., 2017). Evidence can be quantitative data obtained from measurements as well as qualitative data obtained from investigations and literature studies to answer questions, solve problems, or make decisions (McNeill, 2011). According to Tytler (2001), evidence is central to the interaction between science and the public.

The relationship that states between evidence and claim is called warrant (reason). Every claim must contain a strong warrant (Bağ & Çalık, 2017). The warrant can be done based on law, principles, rules, or science theory (Su, 2020). The basis used to express a warrant is called backing. The backing is a basic assumption that serves as a justification or guarantee of the justification conveyed (Bağ & Çalık, 2017). Restrictions on certain conditions where claims do not apply are called qualifiers. The qualifier can mean the power of the data on the warrant to limit claims (Toulmin, 2003). Alternative rejection of the claim submitted is called rebuttal. The rebuttal must be accompanied by stronger supporting evidence or weaken the evidence that has been presented in previous claims (Clark & Sampson, 2008; Hsu et al., 2015). Counter-claims require deeper thinking, as well as good analytical thinking (Kuhn, 2010; Lin, 2014). According to Foong & Daniel (2013), the rebuttal is the most complex component in

argumentation. Rebuttal demonstrates high-level thinking skills (Chang & Chiu, 2008; Lin & Mintzes, 2010). The argumentation component is the basis for assessing the quality of students' argumentation (Venville & Dawson, 2010) and can be used to assess higher-order thinking skills.

Classroom learning changed significantly from offline to online as covid-19 had a major impact on the achievement of learning goals, including students' argumentation skills (Morgan, 2020). Argumentation skills become an alternative ability in solving problems that often occur uncertainly in students' daily lives (Chen, 2020). The urgency of argumentation skills can reflect a high level of thinking skills and encourage important student problem-solving skills to be identified as provisions to deal with the complexity of problems that occur today (Clark & Sampson, 2008). Several previous studies that identified the argumentation profile of students in the classroom, among others, regarding hot matter and temperature at one of Malang high schools showed that the level of student arguments was at levels 2 and 3 (Priyadi & Diantoro, 2018), the buffer solution material at one of Surakarta High Schools showed the level of student argumentation at levels 1 and 2 (Devi et al., 2018). Research on biological learning, one of which is on environmental pollution materials at one Surakarta High School, shows that the argument is dominated by claims with reason, but it is still low in making evidence and rebuttal (Astira et al., 2019), while at the junior high school level shows students can make claims, but difficulty revealing evidence, warrants, and backing (Ambarawati et al., 2020), at the high school level of biology learning at one of Yogyakarta schools showed the level of argumentation students at levels 1 and 2 (Nurmalasari & Ariyanti, 2021). In addition, the ecosystem material at one of Sukabumi High Schools shows that the level of argumentation is dominated at levels 1 and 2 (Rosalinda et al., 2021). Some of the research outlined discusses arguments based on Toulmin. However, the discussion in the study did not discuss in detail the score component of argumentation based on Toulmin, it only discussed in outline the level of argumentation obtained by students. Assessment of the part by the component of argumentation that is less than students becomes a detailed material for teachers to improve the specifics of learning to improve argumentation. The assessment of student arguments through part of the component of argumentation in learning materials in the classroom became the background of research entitled "Profile of High School Students' Arguments on Environmental Pollution Materials in the Covid-19 Era."

2. METHODS

The type of research is descriptive quantitative with a survey method by distributing questions via google form learning KD 3.11 environmental pollution materials. The research population of 172 students in class X IPA at one of Surakarta High Schools. The research sample used was 72 students. Sample determination is carried out by clustered random sampling techniques. The sample was selected by testing the student's initial ability from the value of biology using a paired F test with a $\text{sig} > 0.05$, which means the sample has balanced cognitive abilities.

The research procedure is carried out by making argumentation essay questions totalling 10 questions following the Toulmin Argumentation Pattern (TAP), including 6 components, namely evidence, warrant, backing, qualifier, rebuttal, and claim. The question was validated using the Rasch model obtained a raw explained by measure value of 35.4% for empirical values. The value has met the minimum value requirement of the validity of the construct received (20%), so it can be said that the validity of the instrument construct is relatively good (Sumintono, Bambang & Widhiarso, Wahyu, 2013). The rubric of the assessment of the question is carried out based on the rules of Accar et al., (2015) with details according to table 1 below:

Table 1 Argumentation component score categories

Score	Answer	Description
0.5	Incorrect	The wrong answer according to the answer key, along with the wrong reason
1	Correct	The correct answer corresponds to the answer key but the reason is stated unclearly and irrelevantly
1.5	Correct	The correct answer corresponds to the answer key, but the reason is stated more clearly; some reasons are irrelevant
2	Correct	Correct answer according to the answer key with a clear reason and all relevant
2.5	Correct	Correct answer according to the answer key with a clear reason, relevant and refers to the observation
3	Correct	Correct answers fit the key to the answer with clear, relevant reasons and refer to observation and scientifically correct

The categorization of the score is carried out based on Putri, Sunarno, & Marzuki (2021) in Table 2 below.

Table 2 Argumentation component score categories

No.	Score Range	Criteria
1	$0,5 \leq x \leq 1$	Very low
2	$1 < x \leq 1,5$	Low
3	$1,5 < x \leq 2$	Medium
4	$2 < x \leq 2,5$	High
5	$2,5 < x \leq 3$	Very high

Data analysis techniques are performed by descriptive quantitative with calculations using Microsoft Excel version 2016. Data analysis uses the calculation using the formula below:

$$\text{Percentage of students score } x = \frac{\text{number of students who get a score } x}{\text{number of samples}} \times 100\%$$

3. FINDINGS AND DISCUSSION

The research results presented in Table 3 are:

Table 1. Percentage of students on each in each argumentation component

No.	Argument Component	Score					
		3	2.5	2	1.5	1	0.5
1	E	12,50%	2,78%	18,06%	1,39%	41,67%	23,61%
2	E	0,00%	40,28%	2,78%	0,00%	55,56%	1,39%
3	W	2,78%	0,00%	11,11%	2,78%	83,33%	0,00%
4	W	0,00%	0,00%	0,00%	0,00%	47,22%	52,78%
5	B	0,00%	0,00%	0,00%	0,00%	54,17%	45,83%
6	Q	1,39%	5,56%	1,39%	0,00%	8,33%	83,33%
7	R	15,28%	0,00%	4,17%	1,39%	75,00%	4,17%
8	C	0,00%	0,00%	0,00%	13,89%	83,33%	2,78%
9	C	18,06%	0,00%	0,00%	0,00%	79,17%	2,78%
10	C	0,00%	0,00%	1,39%	0,00%	98,61%	0,00%

The E scores that students built on questions number 1 and 2 were mostly in the score of 1, which was 41.67% of students and 55.56% of students. The difference between E in numbers 1 and 2 lies in the specifications of the material, namely number 1 related to the factors that cause pollution in general and number 2 related to the factors that cause pollution from chemical compounds. The results of the data analysis showed that students build evidence (E) on a score of 1, which is included in the very low category. Students' correct answers are influenced by the understanding of the material as well as the process of identifying evidence that corresponds to the material. Students must learn to understand, to use and evaluate evidence that supports or disproves statements. The lack of student ability to make evidence can be caused by the process of generalizing or interpreting evidence/facts in a phenomenon that is not good (Brown et al., 2010). In addition, the evidence built by students can be optimal with the application of contextual learning that supports it because evidence is based on contextual learning (Brem & Rips, 2000). The basis of applying contextual learning to online learning with the use of phenomena in the daily environment associated with supporting materials according to learning materials in online classes is carried out by students less meaningfully (Widoretno & Dwiastuti, 2016) so that the scores on the student evidence component are still relatively low.

Most students connect claims with evidence using warrants (justification) built by students have a score of 1, which is 83.33% of students on question number 3. Problem number 4 was answered by students with very low score categories at 0.5 and 1 scoring as much as 100% of students. Warrants that are capable of constructing students mostly obtain a score of 1 indicating the quality built is in a very low category. Factors that result in less warrant quality due to reasons for statements in questions that are supported or refuted by students show inappropriate reasons. The difficulty of students in making warrants can occur because students have difficulty making assumptions between statements and evidence because students still use low reasoning (Pratami et al., 2019). A warrant is one of the most important parts of proving the correctness of statements based on learning systems and cognitive processes carried out by students (Faizah et al., 2020).

Support from justifications built by students or backing is built by most students on a score of 1 as much as 54.17% of students, and the remaining 45.83% of students get a score of 0.5. Backing built by the average student being at a score of 1 indicates the quality of the backing is in a very low category. The data shows that students have not been able to make backing because the reasons and supporting theories used are not precise and accurate. Low backing made by students can be caused by the quality of warrants made. The backing can be associated with the warrant and expressed with the word because, as well as the underlying definition and theory (Mejía-Ramos & Inglis, 2009). Good backing preparation can be helped by maximum material mastery, the use of learning resources, and the learning process in the classroom. Backing plays an important role in strengthening warrants, finding ruckles, and qualifying claims (Laamena & Nusantara, 2019).

Student restrictions on statements (claims) or qualifiers built by most students obtained a score of 0.5, which is as much as 83.33%. Qualifiers created by students show most students making qualifiers with a score of 0.5 indicate a very low category. Qualifiers are influenced by evidence. Warrants are delivered to strengthen claims. The qualifier can mean the level of strength of evidence on the claim connected by the warrant (Tristanti et al., 2015). Qualifiers in the form of statements limiting claims do not apply (Toulmin, 2003). Qualifiers made by students are relatively low because they are influenced by evidence that students can identify. Claim exclusion conditions can indicate the level of data strength based on the associated standard logic and may indicate the involvement of substantive evaluations and some context in learning materials (Bizup, 2009; Verheij, 2005). The use of learning resources and experiences obtained by students in class and in everyday life affects the construction of qualifiers that students can make.

The student's rebuttal to the statement (claim) is called rebuttal. For most students, 75% of students made R with a score of 1. The rebuttal made by most students being at a score of 1 indicates a very low category. One of the causes of the low rebuttal made by students is the depth of the material understood by students. The level of understanding affects the quality and complexity of an argument (Venville &

Dawson, 2010). The rebuttal is a complex part because students are forced to give a refutation of claims that have been made themselves. The rebuttal is the most significant part in determining the quality of an argument and are valued as high-level thinking skills (Lin & Mintzes, 2010). Statements or conclusions that can be made by students are called claims. Claims built by students are mostly at a score of 1, namely 83.33% of students, 79.17 students, and 98.61% of students on each question that contains a claim component. The claims constructed by students are mostly still at a score of 1 with a very low category. The answers students build on the submitted statements are less comprehensive. Students provide answers with a less in-depth understanding of the material and low reasoning so the quality of the claims built is low (Faiqoh et al., 2018). The claim is a statement about the information held and leads to conclusions. Claims are strengthened by students' understanding of learning materials (content) and experiences that are relevant to scientific rules (Faiqoh et al., 2018).

The quality of the student's argumentation can indicate the level of the student's understanding of the material and the level of students' thinking. The higher quality of argumentation indicates a higher level of understanding of the material and a higher the level of thinking in the student. Argumentation is a process that requires critical thinking in producing statements and making decisions that are useful for improving students' thinking levels (Zohar & Dori, 2003). Cognitive processes in arguing lead to the process of identifying questions, facts, and knowledge in training the level of thinking of students (Viyanti et al., 2020). Arguments built by students based on the assessment of each component are mostly in the very low category, indicating that the depth of students' understanding of the material is still lacking and the level of student thinking is still relatively low. Park (2016) in his research stated that there is a correlation between the quality of student arguments and understanding of concepts. Concept understanding is needed by students in making or justifying claims, and influencing decisions to defend or refute claims so that the depth of concept understanding greatly affects the quality of the arguments presented by students. Improvement or development of student' arguments need to be done and can be done with a learning process to teach thinking through argumentation (Kuhn & Udell, 2003). Arguments are structurally and conceptually of good quality when students deliver based on everyday experiences and experiences during learning (Park, 2016). Argument-based learning is essential for developing students' argumentative habits in building, evaluating, and comparing claims (Sampson & Gerbino, 2010). The development of the learning process can be done on several things, such as teaching strategies, learning activities, and assessment instruments that are important tasks for science teachers (Lin & Mintzes, 2010)

4. CONCLUSION

The study concludes that student's argumentation scores on each component obtained by students is still relatively low. Most of the students built the argumentation component in the very low score category, namely 0.5 and 1. The total percentage of students in the argumentation component with a score of 0.5 had the following percentage ratio of students E: E: W: W: B: Q: R: C: C: C by 23.61%: 1.39%: 0.00%: 52.78%: 45.83%: 83.33%: 4.17%: 2.78%: 2.78%: 0.00%, and the score 1 obtained by students with a ratio of 41.67%: 55.56%: 83.33%: 47.22%: 54.17%: 8.33%: 75.00%: 83.33%: 79.17%: 79.17%: 98,61%. Some of the factors that cause low student argumentation to include the learning process that occurs less meaningfully, understanding and reasoning of student material being less in-depth, and the process of generalization of evidence or theories that are not appropriate. The shortcoming of this study is the level of supervision that researchers lack because it is done online, making it difficult to prevent cheating committed by students. However, this research can be developed for further research as reference material to improve the quality of student argumentation in each component of argumentation, according to Toulmin.

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