

## IDENTIFICATION OF SCIENTIFIC ARGUMENTATION OF HIGH SCHOOL STUDENTS ON THE ECOSYSTEM TOPICS

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### ABSTRACT

This research to determine the profile of the argumentation skills of senior high school (SMA) class XI MIPA 3, students on the ecosystem material that has been learned. By using descriptive method and quantitative approach. The research was conducted at SMAN 2 Sukabumi in the academic year 2020/2021 with a total sample of 13 males and 23 females in class XI MIPA 3. Purposive sampling is a technique for sampling. This research is a description of 22 questions, and research instruments measure the scientific argumentation skills of students. This question refers to the criteria and indicator level for the Toulmin argumentation pattern. The results of the research in class XI MIPA 3 that the students wrote argument ability was still low, this shown by the results of the highest percentage at level 1, namely 26 % and level 2 at 34%. At the same time, the percentage of the argumentation indicator in rebuttal is only 13%. The student's argumentation skills for men with an average score of 48.2 and women's are 67.5. Therefore, the quality of students written arguments is still weak and needs to be improved again by using a learning approach that can train students written argumentation skills.

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## INTRODUCTION

The 21st century is the ability that must be possessed by students, namely the ability to communicate effectively ([Saavedra & Darleen, 2012](#)). To support this ability, students must have good argumentation skills because scientific argumentation skills can develop 21st-century skills ([Clark et al., 2010](#)) such as critical thinking, evaluation of reason, and reflection ([Bathgate et al., 2015](#)). Scientific argumentation skills can provide students with the right decisions when dealing with scientific issues ([Yacoubian & Khishfe, 2018](#)). Scientific argumentation ability has also been proven to help students and teachers achieve learning goals ([Katsh-Singer et al., 2016](#)). The ability of scientific argument needs to be improved again by students. ([Riwayani et al., 2019](#)).

Argumentation is a method used to understand an issue and express the importance of an issue ([Kuhn, 2005](#)). Argumentation plays a vital role in developing students in critical thinking and can increase knowledge or broad understanding of an idea or ideas ([Song & Deane, 2014](#)).

Scientific arguments either orally or student statements in order to be able to analyze and interpret data based on their knowledge ([Mcneill & Martin, 2010](#)). In addition, the ability of the arguments of scientists can lead to broad knowledge (Helanti, 2014). Scientific argumentation is also a scientific process that must be applied in science learning because science is part of scientific investigation ([Erduran et al., 2015](#)). Using arguments in science education is associated with many benefits, including developing critical thinking skills and improving students' academic performance and conceptual understanding ([Faize et al., 2017](#)). Argumentation is essential for students in learning how to act, communicate, and think, using data or evidence when arguing ([Probosari et al., 2016](#)).

Scientific argumentation can provide knowledge, concepts, scientific reasoning, which can also be done in the discussion. Students' argumentation skills can also be applied in students' daily lives when arguing with the public.

[Choden & Kijkuakul \(2020\)](#) stated that the concept of scientific argumentation is a critical aspect of the scientific inquiry process that requires students to find sufficient evidence and justification to support students' claims. Toulmin's argumentation pattern was adopted, which

required students to develop arguments based on claims, evidence, and other reasons (Zahrok et al., 2017; Toulmin, 2003). Researchers often assist this process as facilitators who ensure that scientific arguments are in the right direction and provide assistance to students to find the best solution to the problem.

The components of the argument indicator Toulmin's Argument Pattern and level criteria developed by [Erduran et al. \(2004\)](#) the main components of TAP are the ability of students to argue, including claims, the ability to analyze data, the ability to include warrants, the ability to provide support, then the ability to give rebuttals to problems ([Suraya et al., 2019](#)). The claim provides a statement following its opinion, followed by indicators in the form of data, facts, evidence, or reasons to support its claim. Guarantee that connects data with claims. Support is a statement to support the claims given. Disclaimers can undermine other claims. Assurance and support part of strengthening students' arguments ([Acar & Patton, 2012](#)).

Previous research on the ability of arguments, according to ([Handayani, 2015](#)) that some students can provide a claim statement does not provide evidence or other argumentative components that can provide the statement to be said to be true. In addition, understanding concepts and reasoning can be seen from how students write their arguments in clear sentences.

Ecosystem learning is closely related to students' daily lives. Ecosystem learning includes students' understanding concepts in arguing, and students are expected to relate these concepts. To link, the ecosystem material can be through the ability of argumentation. As ([Ritonga, 2016](#)) argues that students' argument ability can be linked through students' argument ability.

## METHOD

The research method used is the descriptive method with a quantitative approach. The subjects used in this study were class XI MIPA 3 at SMA 2 Sukabumi for the academic year 2020/2021, with 36 students. There are 13 male students and 23 female students in class XI MIPA 3 who have followed the ecosystem material. The sampling technique used is purposive sampling with some balance from the school by determining the class with the largest number of students, namely in class XI MIPA 3, so the researcher researches class XI MIPA 3.

This research was conducted to determine the scientific argumentation ability of students of class XI MIPA 3 at SMA 2 Sukabumi. Based on interviews with teachers, the school has never implemented learning that can measure students' written argumentation skills. In addition, at SMAN 2 Sukabumi City, there has been no research on the profile of students' written argumentation abilities, so this study aims to determine the profile of students' argumentation abilities on ecosystem materials that students at SMAN 2 Sukabumi City have studied.

This research was carried out on March 29, 2021. Data collection using test questions in the form of descriptions totaling 22, the questions have been declared valid by expert lecturers. The instrument used for this research is a question to determine the student's argumentative ability, which refers to Toulmin's argumentation pattern ability. The quality of students' written arguments can be seen based on scientific argumentation and level criteria adapted from TAP. The rubric of argumentation ability criteria is presented in Table 1.

Table 1. Criteria for Scientific Argument Ability Level

Level	Criteria
1	Argumentation has arguments that consist of one claim and against another claim.
2	Arguments have arguments that consist of claims and then against other claims using data, guarantees, supports, and contain no disclaimers.
3	Arguments have arguments consisting of claims, data, guarantees, supports, and weak rebuttals.
4	Arguments have arguments consisting of explicit claims, data, guarantees, supports, and disclaimers.
5	The argument displays a complete argument, namely the existence of more than one claim, data, guarantee, support, and refutation accompanied by a clear refutation.

[Erduran, et al. \(2004\)](#)

## RESULTS AND DISCUSSION

The ability to argue scientifically is an ability that can train students to play an active role in arguing, then think logically, and students can give reasons when arguing by providing evidence and guarantees.

From the results of the research for class XI MIPA 3, what was measured was the students' written argumentation ability. The scientific argumentation ability of students based on the Toulmin Argumentation Pattern is presented in the graph in Figure 1.

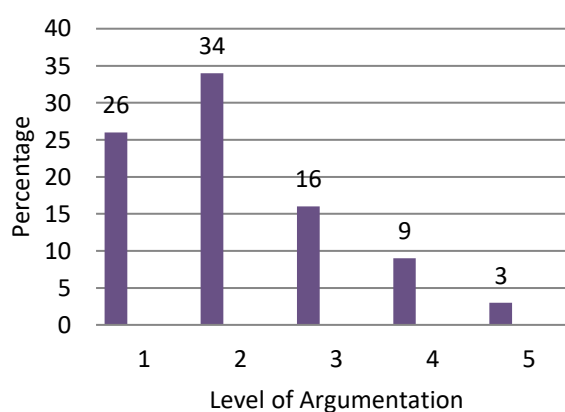


Figure 1. The percentage of students' scientific argument abilities

The research data presented the students' scientific argumentation skills at level 1 (26%), level 2 (34%), level 3 (16%), level 4 (9%), and students at level 5 (3%). Students who answered based on claims and no statements or did not answer were not included in the level category. Figure 1 on the level of student argumentation is

still low because it can be seen from the highest presentation size at level 2, which is 34% of answers. At level 2, there are claims, then data, guarantees, support, and no disclaimers. So that the average argumentation of class XI MIPA 3 students is still weak. Argumentation ability can be presented based on the indicators in Figure 2.

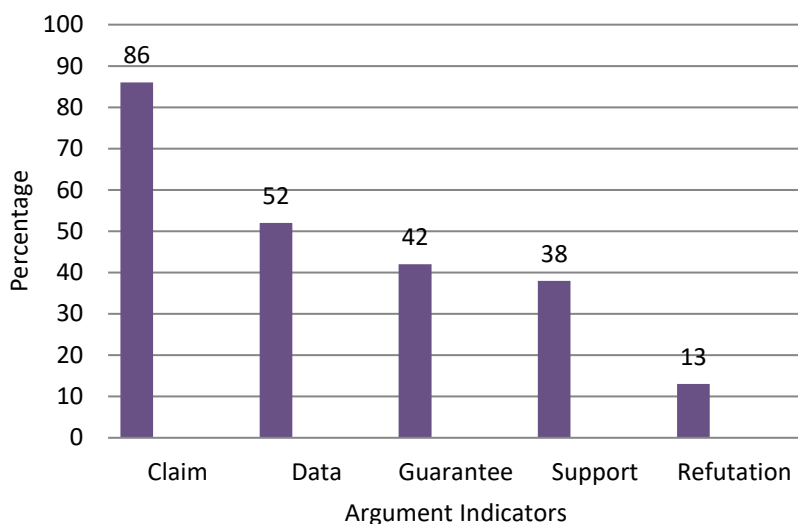


Figure 2. Percentage of Students' Argument Indicators

Based on the data from the research results of students' argumentation abilities in the graph above, it shows that the results of the percentage of students' scientific arguments, the claim indicator has the highest percentage, namely 86%, the data percentage indicator is 52%, the guarantee indicator is 42%, and 38% support, which has indicators the smallest is the disclaimer

indicator only 13%. The level of student's scientific argumentation shows that the higher the level of the scientific argument, the more complex the argumentation indicators of students' answers or written by students. The ability of argumentation based on gender is presented in the graph in Figure 3.

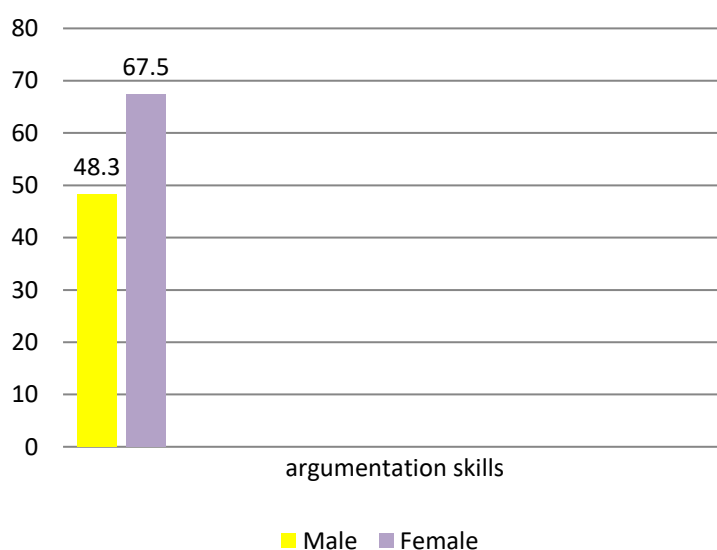


Figure 3. The ability of scientific argumentation by gender

The argumentation ability based on gender (Figure 3) in men's argument ability is still weak. Many male students answer based on a guarantee without any apparent reason and the number of male students who do not include their claims. From this result, the average argument ability of men and women, on average, is male. A score of 48,2 and in women 67,5.

The ability of women's arguments is higher than the ability of men's arguments. Because of the large number of women, as many as 23 people, besides that, the number of women who play an active role in arguing in writing even though only partially, the number of women who answer by claiming, then data, and there are reasons, but female students still do not answer in their guaranteed statements. The reason still gives

one reason, but women's argument ability is higher than men's compared to men.

As [Songsil et al. \(2019\)](#) statement, female students were more confident and braver in expressing their thoughts than male students. Scientific argumentation is one of the skills that students must possess and master in the 21st century ([Atqiya et al., 2020](#)). In this study, it was revealed that the scientific argumentation of female students was better than that of male students. [Faize et al., \(2017\)](#) although the ability of female students with an average of 67.5 is higher while the male students are smaller, the argumentation ability of female students prioritizes the number of claims and reasons that female students answer, but there is still a lack of ability of female students. In an argument, they answer a statement of guarantee, support, whereas, for men, it is shorter and then incomplete based on the argument's level or indicators based on the TAP reference.

Therefore, the argumentation ability of students in class XI MIPA 3 is still low. It is necessary to improve again because training students in arguing in writing in the 21st century is crucial. Especially from the results of research that has been done, the ability to argue men is still very lacking. Therefore, the researcher suggests that male students are more active than the teacher provides methods, models, and learning approaches to take an active role in arguing. They were learning so that all students take an active role in arguing.

The study results show that the argumentation abilities of men and women have different results. This can be illustrated in Figure 3, that the ability to argue based on the gender of women and men, women have higher abilities than men.

Other research shows no consistent gender relationship with self-confidence and perception of knowledge ([Asterhan, 2018](#)). Because the results of this study show students' written arguments based on the male and female gender, women's argument ability are higher in answering argument test questions.

Students' statements at level 1 answer only include claims because the claims answered by students are correct. Some students can only make claims without any evidence, guarantee, support, and disclaimer. At level 1, they only get 26%. So that the students' written arguments are still categorized as low because students argue that they only include claims and do not answer

with data, guarantees, and then support or rebuttal related to other claims. In the argumentation indicator, the percentage of claims has the highest level of 86%. Following the statement ([Noviyanti et al., 2019](#)), students cannot be empowered at the level of argumentation, which means they are included in the category of very weak argumentation level.

The percentage of students' scientific arguments at level 2 is 34%. In this study, the level of argumentation of students in class XI MIPA 3 has the highest level because students argue against other claims based on data, guarantees, and supports, but there is no rebuttal. The argumentation level of students at level 2 has very many levels among other levels. The study results on students of class XI MIPA 3, most students only included the evidence that the student had and the support and claims that the students chose so that their claims could be proven correct. Data and assurance indicators are interrelated indicators indicator. Guarantee also connects data and claim ([Acar & Patton, 2012](#)).

On the indicator of student argumentation, the data is 52% because not all students answer using data and guarantees. This can be seen in the graph of the argument indicator. Many students also answered in the form of data to fight other claims in order to be able to defend students' arguments, therefore the data with different guarantees in Figure 2 because students have more data than guarantees. Therefore, the scientific argument of the students of class XI MIPA 3 at level 2 is still low because the students' answers do not have any rebuttals.

Students at level 3 are 16%. At this level, students answer with claims, then data, support, guarantees, and weak refutation because the refutation of student statements still does not use evidence. According to ([Handayani, 2015](#)), it shows that students' arguments are at level 3 with data, claims, guarantees, and support. Then the level of qualification is still lacking. The argument at level 3 is already quite good and needs to be improved again.

Students at the 4th level (9%) while at the 5th level only (3%) of this level of scientific argumentation in class XI MIPA 3 students are still categorized as low because the arguments answered by students still have not answered the inaccurate claim statement. then data, and guarantees, besides that some students do not answer arguments at levels 4 and 5 only some students.

This written argument is essential for students to understand the concept, answer clearly, provide rebuttals to strengthen the student's argument and be accompanied by data. Students at levels 4 and 5, at level 4 (9%), while at level 5, only (3%) of the percentage level of scientific argumentation in class XI MIPA 3 students are still categorized as low by students who still have not answered. Less precise claim statements than data and guarantees. Besides that, some students do not answer the arguments at levels 4 and 5, only some students. (Hasnunidah et al., 2020) Argumentation can provide a solid basis for understanding the concept entirely and correctly. Because by arguing in writing, students need to understand the concept and then answer clearly, can provide a rebuttal to strengthen the student's argument and be accompanied by data. At level 5, according to (Erduran et al., 2004), the argument is complete, and there is more than one rebuttal. The percentage at levels 4, 5 is still low because the indicator of the argumentation is still weak on the support indicator as much as 38%, and the argumentation indicator of refutation is only 13% of the two argumentation indicators low. This happens because students rarely answer support and refutation. the percentage of argumentation of research results in class XI MIPA 3 still needs to be increased again because the level that students have is still low at levels 4 and 5, different from other levels.

The ability of students' scientific argumentation on ecosystem material in class XI MIPA 3 shows that students' ability to argue is still low, so it needs to be improved. This class's low ability in written argumentation is due to many students who still answer at level 1 with 26% and level 2 as much as 34%. Because most students answered at levels 1 and 2, some students do not understand the material or lack understanding of the concept of ecosystem material that students have studied. Students are also not familiar with scientific arguments because they do not facilitate students when arguing in their previous learning. The ability of arguments based on gender from the results of research conducted shows that the argumentation ability of men is lower, and the ability of written arguments in women is higher. Both male and female students' written arguments need to be improved again by frequently training students in stating their arguments. train their arguments in a way that students are actively involved when arguing. Based on this explanation, Trainarch on students' argumentative abilities needs to be trained so that students' ability to argue can increase, one of which is by applying

models, methods, and learning approaches so that students' written argument skills can increase.

## CONCLUSION

Based on the research results that have been carried out, the scientific argumentation ability of students in class XI MIPA 3, SMAN 2 Sukabumi City for the 2020/2021 academic year shows that students' written argumentation skills are still low. This study also has limitations that affect student arguments, namely the lack of male student participation and student activity during learning. Most of the students' argument ability is still at levels 1 and 2. Some students have not used the rebuttal indicator, so the refutation is still weak. In addition, learning in class XI MIPA 3 has not facilitated students' writing arguments, so students are not used to filling out argumentation test questions. In addition, the argumentation ability of students for males with an average of 48.2 and females as much as 67.5 based on gender, students' written argument skills for women are higher and for men are still weak. Therefore, the students' scientific argumentation skills, which are still low, need to be improved by using a learning approach to improve written scientific argumentation skills.

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