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Junior High School Students Scientific Argumentation Skills on Conventional Biotechnology Materials

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A B S T R A C T

Argumentation skills are included as an important features for critical thinking that need to be trained to students. Being involved in argumentation leads students to be able to put forward arguments that are supported by data and scientific reasoning. The purpose of this study was to analyze students' scientific argumentation skills on biotechnology material using the Argument-Driven Inquiry (ADI) model. The method in this study used a qualitative descriptive method. Students' scientific argumentation skills during the learning process were analyzed from transcripts of audio recordings and learning videos known as Transcript Based Lesson Analysis (TBLA). The results of this study indicate that learning with the Argument-Driven Inquiry (ADI) model can build students' scientific argumentation skills. The six categories of social negotiation have been identified from student conversations when involved in scientific arguments, but are still dominated by the idea construction components, namely information seeking and elaboration. Meanwhile, the components of criticism of ideas including challenging, supporting, rejecting and defending are not often used by students. This is due to the limited knowledge of students about the material and the low understanding of epistemic arguments where they are not accustomed to using scientific evidence to support their claims.

1. Introduction

The skills that students need to have in facing the 21st century with the guidance of an increasingly competitive era are often referred to as 4C skills including critical thinking and problem solving, communication skills, collaboration skills, creativity skills and innovation. Critical thinking means skills in examining assumptions, distinguishing hidden values, evaluating evidence, and assessing conclusions (Fuad, 2017). Matindas (in Zubaedah, 2010) reveals critical thinking as a mental activity carried out to evaluate the truth of a statement. Generally, the

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evaluation ends with a decision to accept, deny, or doubt the truth of the statement in question. We can conclude that critical thinking is a complex intellectual process with various skills to make appropriate decisions or problem solving.

Critical thinking skills are closely related to scientific argumentation skills. Argumentation is a central component of critical thinking and is important in welcoming the 21st century (Ennis, 1985); (Crowell & Kuhn, 2014). Argumentation refers to the process of assembling the components of an argument or in other words, arguing (Simon et al., 2006). Argumentation can also be defined as the act of organizing evidence and theory to support and refute the conclusions of explanations, models, and predictions for the purpose of justifying one's knowledge and persuading one's ideas to others (Neill & Pimentel, 2009). in the process of verbal and written arguments. Reinforced by the presentation of Roviati (2019) stating the contribution of argumentation to the development of critical thinking skills, namely assessing sources of information, evaluating arguments and generating arguments and presenting them.

From a linguistic perspective, argumentation is seen as a series of language practices in which scientists construct and criticize each other's arguments through negotiating the meaning of texts, pictures, diagrams, tables, and other representations (Klein, 2006). Social argumentation is a powerful tool for developing higher-order thinking which is called internal argumentation. In other words, social dialogue offers a way to externalize internal thinking strategies embedded in argumentation (Jimenez-Alexandre & Erduran, 2007). In this study, students' scientific argumentation skills were viewed from the aspect of social negotiation and epistemic understanding of arguments, it can be defined that argumentation skills are someone's skills in constructing and criticizing one another's ideas in order to negotiate to establish the truth of knowledge by expressing scientific evidence-based claims that can accounted for.

Determination of the argument from the aspect of social negotiation and epistemic understanding of the argument refers to Chen's framework. There are 2 main components with 6 categories of social negotiation, namely the construction of ideas (information seeking and elaboration) and criticism of ideas (challenging, rejecting, supporting and defending). Furthermore, it is related to the epistemic understanding of arguments using 3 main components of scientific arguments, namely questions, claims and evidence. The information seeking category includes verbal reactions intended to ask for additional information about an idea, which consists of 2 subcategories representing aspects that students seek more information, namely test procedures and data sources. The elaboration category includes utterances intended to ask for more explanation and articulation of ideas including accuracy of claims, quality of evidence. The challenging category includes utterances intended to evaluate the proposed idea, with subcategories test procedure, the relationship of question-claim and claim-evidence, the quality of claim and evidence. The defending category represents the words of students who are trying to persuade their friends, developed into two subcategories, namely simple answer and evidence-based. The supporting category is what students say to voice their agreement with their friends, which consists of two subcategories,

namely simple supporting and evidence-based. The rejecting category represents the words of students who voiced disagreement with their friends, which consists of two subcategories, namely simple rejecting and evidence-based (Chen et al., 2016).

Various efforts have been made by researchers to facilitate student involvement in scientific argumentation, one of which is by applying the Argument-Driven Inquiry (ADI) learning model. The ADI model is rooted in the theory of social constructivism, which was developed with the aim of providing more opportunities for students to develop the understanding and skills needed when participating in scientific argumentation during learning through social interactions with teachers and other students (Sampson et al., 2011). The results of the study by Sampson showed that students' engagement and production of their arguments were better after the intervention using the ADI learning model. This is also supported by the findings of Farida's research (2018) which states that the application of the ADI learning model has a significant effect on increasing students' argumentation skills, in this case women are higher than men.

Based on the results of the researcher's interview with a science teacher at a State Junior High School in Payakumbuh District, District 50, West Sumatra City, it was stated that science learning is often done using conventional methods and science in the eyes of students is a lesson that is less attractive so that the character of students when learning takes place tends to be silent. The involvement of students in the learning process is still low, from 18 students only about 5-8 students are enthusiastic. Osborne (2005) also states that in science learning the opportunities given to students to examine, engage, provide arguments that lead to the construction of scientific explanations are not developed. In addition, in terms of scientific argumentation skills, students have not been able to provide critical or evidence-based opinions, including contextual material for students, one of which is material on conventional biotechnology products such as tape, bread and yakult. Therefore, applying the ADI learning model to facilitate these activities is the right solution, because there is a syntax for this model, namely the generation of data and argumentation sessions that support the achievement of these indicators.

Learning with the ADI model on conventional biotechnology materials is expected to build students' scientific argumentation skills. To reveal the profile of the scientific argumentation skills, an analysis of the audio transcripts and learning videos was carried out. Thus, it can be concluded that the aim of this research is to analyze students' scientific argumentation skills from the aspect of social negotiation and epistemic understanding of arguments on conventional biotechnology materials using the ADI model learning.

2. Methodology

The method in this study used a qualitative descriptive method, namely research that displays the phenomenon as a whole (Wiersma, 2009). The focus of this

research was to analyze students' scientific argumentation skills from the aspect of social negotiation and epistemic understanding of arguments by applying 7 syntaxes of the ADI learning model, namely identification of the task, the generation of data, production of a tentative argument, argumentation session, creation of a written investigation report, double-blind peer review and revision of the report (Sampson et al., 2011). In this case, the researcher acted as a model teacher and was observed by 3 observers, the research subjects consisted of 18 grade IX students in one of the public junior high schools in Payakumbuh District, Lima Puluh Kota Regency, West Sumatra Province. Learning analysis was carried out based on transcripts of each student's speech from audio and video recordings known as Transcript Based Lesson Analysis (TBLA), aiming to understand the characteristics of learning by dividing it into several segments so that it can focus on analyzing student activity from the learning dialogue (Arani, 2017). Students' verbal argumentation skills from aspects of social negotiation and epistemic understanding of arguments were identified using 6 main categories with 11 sub-categories from Chen's Framework.

3. Results and Discussion

The seven syntaxes of the ADI learning model were implemented in two meetings. Syntax or steps 1-3 in the first meeting, while steps 4-7 in the second meeting due to limited learning time during the Covid-19 pandemic. The discussion of the steps of the ADI model to build scientific argumentation skills from aspects of social negotiation and epistemic understanding of arguments is as follows:

a. Identification of The Task

In this first step, the teacher introduces the main topic through apperception and motivational activities. In this activity, the teacher showed an experimental video of blowing a balloon with yeast accompanied by questions and answers about conventional biotechnology products in the surrounding environment. With the social interaction between students and teachers or between students, indirectly at this stage students are stimulated to engage in scientific argumentation. In this step the teacher can present information about what is considered a quality argument in science, explain questions or assignments that students will complete (Sampson et al., 2011). Based on the learning transcripts, students have started to use two categories of social negotiation during scientific arguments, which are dominated by elaboration and the categories of information seeking and rejecting appear occasionally. However, judging from the structure of the argument when the teacher asked questions, the students' answers were still in the form of simple claims that were not yet evidence-based.

Table 1. Student Conversations at the Identification of The Task Stage

Subject	Remark	Category
Teacher	So, if you ask, do we really need yeast to make tapai?	
Student	Yes	
Teacher	How do you know? who can provide the proof? It can be from their own experiences or see their parents at home.	
Student	Shut Up	
Teacher	Come on..don't be afraid, it's okay...	
Student 1	Try it, rafil!	Elaboration
Student 1	Sweet potato will be soft...	Information seeking
Teacher	Is not it? (sounds asking with the member to	
Student 1	Good, sweet potato will be soft, how did rafil know?	Elaboration
Teacher	ee try boo,	
Student	Aa,, Rafil he has tried at home or maybe he saw his parents making tapai. Anything to add? How do people make the tapai?	
Teacher	Shut Up	
Student	Aa, haikal	
Teacher	Shut Up	
Student 2	Farhan?	Elaboration
Teacher	Boiled	
Student 3	Aa,, boiled, what else?	Elaboration
Teacher	aa..diuwok (steamed)…diporam (fermented)	
Student 2	We immediately poram (fermentation) after boiling?	Elaboration
Student 4	ee… sprinkled with yeast first	Rejecting
Teacher	Cool first, cool down	
Student 2	So let's chill first, after that?	Elaboration
Teacher	Freshly given yeast	
Student	Well, just sprinkled with yeast, after that?	Elaboration
Teacher	We pack	
Student	aa..we wrap it, with what is it wrapped?	Elaboration

One of the improvements in the future so that students can elaborate the answer in its entirety is that the teacher can present in the form of pictures the procedure for making the tape.

b. The Generation of Data

In this second step, students work together in groups to determine an inquiry design that can answer the questions that have been determined in the previous step. Students are led to be able to collect data and analyze it as a provision for the next step. In this study, the teacher provides creative space for students to design their own experiments, especially with regard to the treatment of the independent variable, namely yeast and the manufacturing procedure is also not written in the work instructions. Gradually and still under the guidance of the teacher, fellow students are increasingly involved in social interaction and they are actively working.

Based on the learning transcript, this step facilitates the development of students' scientific argumentation skills in social negotiation, especially in terms of information seeking and elaboration. Meanwhile, the defending, supporting, rejecting and challenging categories have also been identified from student conversations, but the frequency and students involved have not been as much as the previous two categories.

Table 2. Student Conversations at The Generation of Data Stages

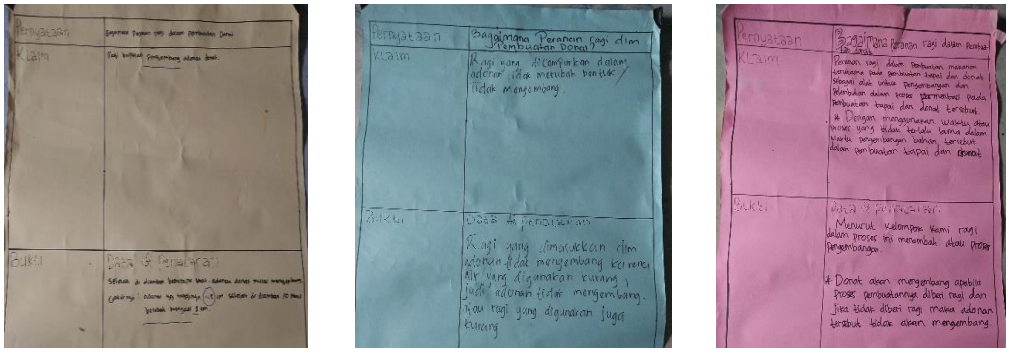
Subject	Remark	Category	Sub-Category
Student 7	How Many Spoons Of Yeast E?	Information Seeking	Test Procedure
Student 2	Just Enter One	Elaboration	
Student 8	Two By Two	Rejecting	Simple
Student 2	Are You Here For It?	Information Seeking	Test Procedure
Observer	Here You Can, Here You Can		
Student 2	Two, Yeast Two Huh?	Information Seeking	Test Procedure
Student 8	Yes	Elaboration	
Student 2	What Is The Yeast Like?	Information Seeking	Test Procedure
Student 9	Let Me See..		
Student 2	Is This Rol?		
Student 7	Yes	Elaboration	
Student 7	One Scoop, Two Scoops?	Information Seeking	Test Procedure
Student 8	Two	Elaboration	
Student 3	What Two?	Information Seeking	Test Procedure
Student 8	Yeast	Elaboration	
Student 7	Oh, I Don't Know If It's Up To 2 Spoons Or Not. Just A Spoonful..	Rejecting	
Next Transcript…			
Student 1	How Many Tablespoons Are You Guys?	Information Seeking	Test Procedure
Student 6	16	Elaboration	
Student 1	16, Why Are You Like This?	Challenging	Test Procedure
Student 6	(No Response, Laugh A Little)		
	How Many Spoons Is This? (Ask For Other Ingredients)	Information Seeking	Test Procedure
Student 5	Do Not Know		
Next Transcript…			
Student 5	Hey, Is There Any Salt?	Information Seeking	Test Procedure
Student11	No		
Student 5	Later I Don't Feel Like It	Elaboration	
Student 6	Are We Going To Eat This Later?	Challenging	Evidence
Student 5	Yes, Even So..	Defending	Simple
Student 5	How Much Salt Is The Pin?	Information Seeking	Test Procedure
Student 3	Salt, 1, Spoon, Teaspoon Yes	Elaboration	

c. Production of a Tentative Argument

In this third step, students are led to write down their arguments to answer the investigative questions in a media that will be clearly visible to be presented later.

The format of the student's written argument structure refers to Chen's framework which consists of three components, namely questions, claims and evidence (data and reasoning). This step can help students to develop a basic understanding of what is considered an argument in science as well as determine valid and relevant evidence to support claims (Sampson et al., 2011).

Based on the learning transcript, when students discussed answering research questions and writing down their arguments, it was known that not all students were involved in conveying arguments. Therefore, the social negotiation process is not optimal, and one of the alleged causes is the limited knowledge related to the material and the low interest and motivation of students in learning. Anticipation that teachers can do in the future is to facilitate diverse, interesting learning resources such as teaching materials and interactive media and each student is asked to write down their arguments after group discussions which will be given feedback by the teacher. Evaluation of students' written arguments showed that 2 out of 3 groups were able to write claims correctly (Figure 1), but the quality of supporting evidence and its coherence needed to be improved.



Group 1 Group 2 Group 3

Figure 1. Students' Written Arguments

d. Argumentation Session

Sharing arguments with other groups, criticizing each other to establish true and scientifically valid claims is the essence of the argumentation session. This step begins with the presentation of the work by one group representative only due to the limited learning time. In this case, the representatives from group 3 have dared to come forward and read out their work. Based on the learning transcript, it was identified that several categories of social negotiation had emerged when students argued, including:

1) Supporting, Elaborating and Defending

Table 3. Student Conversations at the Argumentation Session Stage

Subject	Remark	Category	Sub-Category
Teacher	So, first, Farhan, what did Farhan say?		
Student1	Which one?		

Subject	Remark	Category	Sub-Category
Teacher	That one, the statement of group 3. How about Farhan's group?		
Student1	Agree, just agree	Supporting	Sederhana
Teacher	Agree, why agree Farhan?		
Student1	(unable to answer: scratching head)		
Teacher	Tell me about your results yesterday, how were the results?		
Student1	Still can't (laugh" a little with friends)		
Teacher	Or women (some students raise their hands)		
	Good, please Zilla. Why did Zila agree?	Supporting	Evidence-based
Student 2	Because the manufacture of yeast is very important in the manufacture of dough buk		
Teacher	If it is very important, what is it important for?	Elaboration	
Student 3	For dough development		
Teacher	Any proof yesterday?	Defending	Simple
Student 3	There is		
Teacher	What's the proof?	Defending	Evidence-based
Student 3	The dough that has been given yeast is allowed to stand for a while and will expand		
Teacher	Silent for a while, proved he expands?	Defending	Simple
Student 3	Proven		
Teacher	Evidently, what is the initial height?	Defending	Evidence-based
Student 3	1.5 centi		
Teacher	High after silence?	Defending	Evidence-based
Student 3	2 centi		

The series of dialogues above show that some students still provide simple or unscientific support, but at the end there are students who strengthen group agreement by elaborating evidence in the form of data obtained from experimental activities and trying to convince the teacher and friends. However, here students have not been able to convey the reasons why the data can support their claims. Related to the transcript above, the teacher should add a stimulation question, namely "why does the yeast make the dough rise?". With this we can find out how students respond later we can find out their interpretation of the data (reasoning).

2) Reject

There are different claims from the research question, in this case the group whose experiment was not successful (group 2) had an argument that the yeast did not change the shape of the dough while the other two groups stated otherwise. After group 2 explained the results of their work and how they carried out the experiment, the follow-up effort to determine the accuracy of the teacher's claim asked for the group's response again. In this case, there is 1 group that expresses rejection of the arguments of group 2.

Table 4. Student Conversations at the Argumentation Session Stage

Subject	Remark	Category	Sub-Category
Teacher	The question is: what is the role of yeast in making donuts?		
	Aa, there is a claim/answer from a friend stating that "yeast does not change shape or does not expand" this is their answer. Do you accept that this is the claim?		
Student 1	Not..	Rejecting	Simple
Teacher	Ah, try to say!		
Student 1	We did not receive statements from kel.2 because of ee, because of what…(looks and sounds students are thinking about what the connection is from his speech). Therefore, the teacher provides the following assistance..	Rejecting	Simple
G	Because, is there any evidence?		
Student 1	Because it is proven from the statement that we do..	Elaboration	
Student 2	Donuts don't expand	Elaboration	
Student 3	Donuts expand	Elaboration	
Teacher	What's the proof?		
Student 3	The donuts we make are experiencing development	Rejecting	Evidence-basede
Teacher	What's added yeast?		
Student 3	Yes..		
Teacher	Then?		
Student 3	Dough that is not added yeast does not experience development.	Rejecting	Evidence-basede

The series of dialogues above show resistance which is initially simple but can be supplemented by evidence during the interaction. Although the evidence is not sufficient and there is no explanation of the data or only report the data as evidence.

3) Challenging and Defending

The teacher challenged the students by asking about the halalness of the donut bread after it was previously explained that the fermentation reaction by yeast will produce CO2 gas and alcohol. There are students who oppose the accuracy of his friend's claims and he tries to elaborate and defend his argument. In this case, the supporting evidence comes from personal opinion and experience, but through dialogue guided by the teacher, they can slowly provide scientific answers.

Table 5. Student Conversations at the Argumentation Session Stage

Subject	Remark	Category	Sub-Category
Teacher	Believe it or not? Op Syahril..! it turns out that yeast turns sugar into alcohol, does that mean we eat alcohol? Eat our alcohol when we eat bread?		
Student	Yes..yoi	Elaboration	

Student 1	Why is that so..?	Chalenging	Question of evidence
Student 2	A different kind of alcohol, maybe a different kind of alcohol.	Elaboration	
Teacher	Aa, try, why if yes, it means that donuts are not halal?		
Student 1	Halal, a little is okay, if a lot of people just get drunk (attached to the teacher's voice wave)	Elaboration	
Teacher	Aa, here's the key, the yeast converts sugar into CO2 and alcohol. Aa if there is alcohol, why can we eat bread?		
Student 1	A little is okay, if a lot of people just get drunk (laughs a little)	Defending	Simple
Teacher	But if a lot later, a lot of yeast?		
Student 1	Drunk..drunk	Elaboration	
Teacher	Aa, why is all bread in the market halal, everything is made with the help of yeast		
Student 1	Yes, it's lawful...	Elaboration	
Teacher	Where do you know it's halal?		
Student 3	From MUI	Elaboration	
Student 1	Tested yesterday..	Elaboration	
Teacher	So, yesterday was tested drunk?		
Student 1	I'm not drunk, I made it	Defending	Evidence based
Teacher	Does that mean it's halal, from MUI halal?		
Student	Halal		
Teacher	Halal, so the bread is halal. Where does this CO2 and alcohol go?		
Student 4	Evaporate	Elaboration	
Teacher	Ah good, what happened?		
Student 4	Evaporation	Elaboration	
Teacher	Evaporation, when does he yawn?		
Student 5	In development	Elaboration	
Teacher	Aa, in the development there is steam. Then the bread has been developed how again?		
Student 5	In the oven..	Elaboration	

e. Creation of a Written Investigation Report

This step leads students to write scientifically related to the results of their discussions like a scientist. After attending the argumentation session and obtaining various knowledge from other groups, at this step each group was asked to re-write a report related to the implementation and results of the experiment and write down arguments related to research questions. The following is an excerpt from a report from one of the groups (Figure 2 and Figure 3).

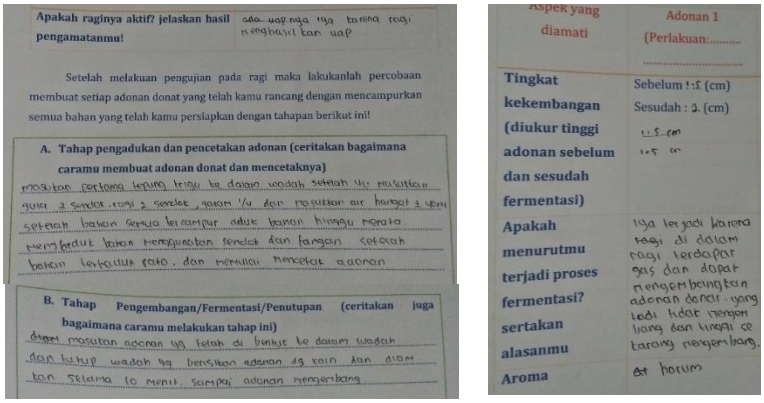
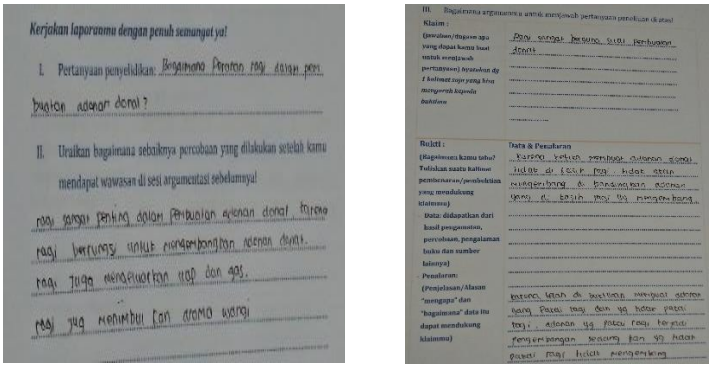


Figure 2. Explanation of Implementation Steps and Student Experiment Results (Before Argumentation Session)



Student Written Report
(After Argument Session)

Figure 3. Student Written Investigation Report

Based on the excerpt above, the researcher deliberately compares the stages before and after the argument because they are interconnected. In general, the results of students' written reports after the argumentation session were reviewed in terms of the coherence of claims and questions and the quality of the evidence was not optimal. For example, in "point II" written report, the essence of the question requires students to explain the experimental steps correctly, but the students' answers are not correct. Whereas in the previous stage (implementation of experiments before the argumentation session) at the core of the same question (different sentence editor) students were able to explain correctly and completely. Furthermore, it is related to the quality of evidence, in terms of adequacy and insufficient explanation. However, analyzing the students' answers to the experimental results, in fact they have obtained scientific data and have written quite scientific explanations regarding yeast fermentation.

Responding to this, indicates the need for reflection during and after learning for a teacher in order to understand the learning process as a whole. Regarding the problems above, the teacher should review the clarity of questions and affirmation sentences related to evidence (data and reasoning) on the student report form.

Then to protect some students who have not participated in social negotiations, the teacher can provide direct feedback individually for students who are active and willing to work.

f. Double-blind Peer Review

This step facilitates students to evaluate the work of other groups by providing appropriate comments. Indirectly, this step leads students to be more critical and master the lesson content to be able to provide logical responses. The results of this stage show that students have written their comments for each aspect that is assessed but the reasons for the assessment are not completely correct. Therefore, to ensure its validity, the teacher needs to review every report that has been assessed by colleagues.

g. Revision of The Report

The results of the assessment by peers are collected by the teacher, and for groups whose work needs to be revised it will be submitted back to the group to be perfected. In this study, there is 1 group which from peer assessment needs to be revised because there are several parts that have not been done. At the end of this stage, the teacher can provide reinforcement related to the essential material as well as guide students to conclude the lesson. Based on the transcript in the closing section, the process of social negotiation (challenging) occurs when a student answers differently from the teacher's questions.

Table 6. Student Conversations at the Revision of The Report Stage

Subject	Remark	Category	Sub-Category
Teacher	Lastly, what is the conclusion of this 2 day meeting? What can you know and get from this lesson, try 1 person per group if you can..		
	Fadli, Fadli was a good read..		
	What did Fadli get from the reading earlier?		
Student1	(Still a little less daring to start talking)		
Teacher	What can Fadli say, didn't Fadli read the text that you gave?		
Student 1	aa..(still thinking)		
Student 2	What, let's try Fad?		
Teacher	What is the title of our material, Fadli?		
Student 1	The role of yeast in making donuts..	Elaboration	
Teacher	Aa, what is the role of yeast in making donuts?		
Student	Developer	Elaboration	
Teacher	Donuts are products from?		
Student	Biotechnology	Elaboration	
Teacher	Conventional or modern?		
Student 4	modern eh..	Elaboration	
Student 1	Conventional can, modern can also	Elaboration	
Teacher	Why is it modern?		

Subject	Remark	Category	Sub-Category
Student 3	Because the manufacturing technique can use a machine, right?	Elaboration	
Student 4	Where did modern e Fad come from? The donuts come from the village…	Challenging	Quality of claim
Student 1	Fadli still can't give a reason		
Student 4	I don't accept this Fad..	Challenging	Quality of claim
Teacher	Aa iyo, traditional nan niak, modern nen yak, or modern deck..		
Student 4	From modern dapek mano e Fad, the donuts come from the village It's not modern..	Challenging	Quality of claim
Teacher	Fadli, please speak, maybe he read it earlier.		
Student 1	Reading the teaching materials given, "Based on the explanation above, biotechnology is broadly divided into two categories, namely conventional (traditional) biotechnology and modern biotechnology"	Elaboration	
Student	Wooow (clap everyone)		

Based on the transcript above, it seems that there is no agreement on the truth of the matter in dispute because the answers from students who were challenged by their friends to provide evidence of their claims were still not correct and there was no explanation. This is influenced by the lack of knowledge related to the material and there are still many students who do not dare to express their arguments. To confirm the truth, the teacher provides additional explanations regarding these conventional biotechnology products.

4. Conclusion

The implementation of the ADI learning model is a solution to facilitate students in developing an understanding of the nature of scientific arguments as well as being a moment for students to be directly involved in the practice of argumentation. Based on the results of data analysis from learning transcripts, it was concluded that the six categories of social negotiation had been used by students when they were involved in arguments. However, this study was dominated by the idea construction component (information seeking and elaboration), 16 of the total 18 students were already involved, although some of them still occasionally gave arguments. Meanwhile, the use of critical components of ideas (challenging, rejecting, supporting and defending) which is an important component in the argumentation process is still rarely used by students. In this case, students are not used to debating, justifying claims with evidence and providing explanations why evidence (data) can support claims. The quality of evidence presented by students focused on only reporting experimental data as evidence and also evidence derived from personal opinion and experience. The causes of this include the limited knowledge of students regarding the material,

their tendency to study using conventional methods so that there are still many students who do not dare to speak. In addition, the short implementation (only one time) of this ADI model, of course, has not been able to provide maximum results from all aspects. Engaging fully in scientific argumentation takes time and continuous practice. However, at least the results of this study indicate that the implementation of ADI in science learning has been able to build students' scientific argumentation skills.

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