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Implementation of the Interactive E-LKPD for Biotechnology Materials with the Argument-Driven Inquiry (ADI) Model Oriented to Improving the Argumentation Ability of Middle School Students

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Abstract

This study aims to describe the effect of implementing interactive e-LKPD on biotechnology materials with the Argument-Driven Inquiry in improving argumentation skills. This study involved 60 grade IX students in a public junior high school in South Lampung, Lampung Province. Quantitative method with non-equivalence pretest-posttest control group has been applied with 30 students in the experimental group and 30 students in the control group. Students in the experimental group get learning assisted by interactive biotechnology e-LKPD with the Argument-Driven Inquiry, while students in the control group are taught using Discovery Learning. The results showed that students who were taught using the Argument Driven Inquiry had N-Gain (g= 0.63) than students in the Discovery Learning (g= 0.28). Furthermore, the effectiveness of biotechnology learning using the Argument-Driven Inquiry shows a high category (ES = 0.90). This shows that the interactive e-LKPD with the Argument-Driven Inquiry effective for improving argumentation skills.

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INTRODUCTION

Entering the 21st century, the development of science and technology has many challenges in global competition that cannot be separated from the quality of education (Abidin et al., 2017). The development of educational science requires quality human resources with various abilities (Wustenberg et al., 2014). By. Therefore, today's learning must be able to develop 21st century abilities, namely *critical thinking, communication, collaboration* and creativity (Pritasari et al., 2016)One of the communication skills is the ability to argue which is the main thing that underlies students to learn how to think, act, and communicate which can be strengthened by the presence of data or evidence (Noer et al., 2020). Argumentation can change learning that focuses on memorization activities towards learning activities that involve students in scientific practice by building and justifying knowledge claims (Supeno & Endang, 2015; Berland & Reiser, 2009). The ability to argue makes students have logical reasoning, clear and rational explanations of the things they learn about scientific phenomena that occur in everyday life based on scientific theories/concepts (Osborne, 2010).

Argumentation skills are important to be empowered in learning. Arguments are still rarely used in science education and laboratory activities (Driver et al., 2000; Jimenez, Rodrigues, & Duschl, 2000). The discussions were still weak and some students were not involved in arguing (Zohar & Nemet, 2002; Jimenez, Rodrigues & Duschl, 2000; Sampson etal., 2011). In addition, in research conducted by Afgani et al., (2020) it is stated that some teachers (55-60%) in Bandar Lampung are aware that the argumentation ability of students is still low. One of the learning models that can train scientific argumentation skills is *Argument Driven Inquiry* (ADI). According to Sampson et al., (2011), the ADI learning model is designed to help students understand the procedures for making scientific explanations, generalizing scientific facts, using data to answer scientific questions and ultimately reflecting on the work they have done. The ADI model has the potential to develop argumentation skills in the biology learning process (Hasnunidah, 2016). This is in line with research conducted by Marhamah et al., (2017) that the implementation of the ADI model in learning is able to improve students' argumentation skills from level 1 to level 3. In addition, the research conducted by Khusnayain et al., (2013) using the ADI model LKS can obtain a higher scientific argumentation skill score than the conventional model.

Learning model *Argument Driven Inquiry* is appropriate to use in learning the subject matter of biotechnology because this material has a problem or real physical phenomena that are often encountered in everyday life, so that students have no difficulty in making scientific investigations. Biotechnology is a branch of biology that studies the utilization and improvement of the potential of living things for human welfare (Amalina et al, 2018). Biotechnology is an interdisciplinary field involving various disciplines including biology, chemistry, biochemistry, molecular biology, genetics, immunology and microbiology. The scope of biotechnology is very broad which includes agricultural biotechnology, health biotechnology, industrial biotechnology, and marine biotechnology (Wardani, Wijayanti, & Widyastuti, 2020). Learning the basic material of Biotechnology in science subjects Curriculum 2013 SMP/MTs class IX, students need to achieve basic competencies KD 3.9 Applying the concept of biotechnology and its role in human life and KD 4.9 Making one of the conventional biotechnology products that exist in the surrounding environment.

The application of the ADI model in learning the subject matter of Biotechnology which is directed at students' activities in investigation, argumentation, writing, and review requires appropriate worksheets. Student Worksheets (LKPD) are teaching materials that contain material, summaries and assignments that have been packaged with learning instructions to make it easier for students to learn and understand learning materials (Candra *et al*., 2016). According to Kristyowati (2018), LKPD is very important given to students to be more active in learning, improve critical and creative thinking skills and be able to collaborate in accordance with the demands of the 21st century. LKPD can be used as a good guide in facilitating student learning activities and their creativity, as well as

an effort to equip knowledge and skills so that student learning success can be achieved (Kistiono & Muslimin, 2017). Although the *Argument-Driven Inquiry* has been widely applied in various science lessons, there are still few that are implemented with the help of electronic teaching materials (LKPD), especially during the COVID-19 pandemic. This research focuses on efforts to improve argumentation skills on the topic of biotechnology.

METHODS

The research design used by the researcher is the *Nonequivalent Control Group Design*. The experimental class uses the ADI model and the control class uses the *Discovery Learning*. The drawings of the design are as follows:

Table 1. Research Design

Group	Pretest	Treatment	Posttest
Experiment	O_1	X	O_2
Control	O_3	-	O_4

Description:
O_1 : Pretest experimental class
O_3 : Pretest control class
X : Learning treatment with interactive e-LKPD with *Argument-Driven-Inquiry*
O_2 : *Pretest* experimental class
O_4 : *Posttest* control class

Diagrammatically the treatment of the two classes is described as follows:

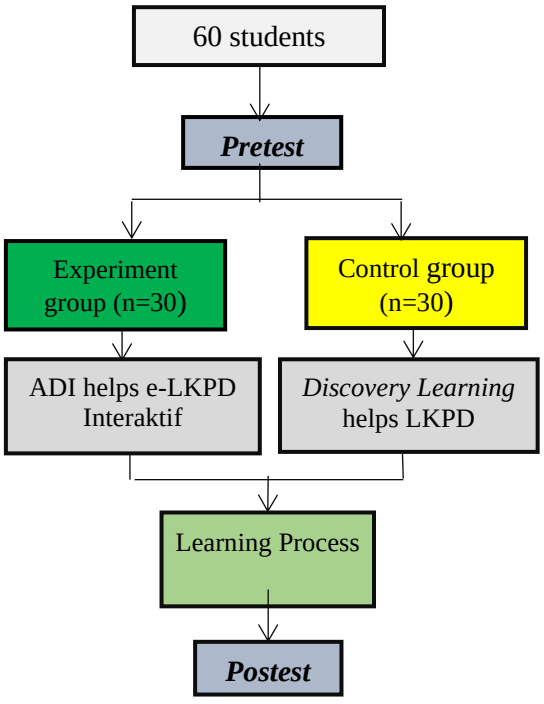

Figure 1. Quasi Experimental Diagram

The instrument used in this research is a *pretest* and *posttest* which has been validated with a score The counts are 0.661, 0.711, 0.554 and 0.854, respectively, so that they meet the valid criteria. Also, the reliable value is 0.613 with moderate criteria. For this reason, measuring the quality of students' argumentation in the learning process can be measured using the assessment developed by Hazeltine (2017) which is presented in Table 2.

Table 2. Quality of Argumentation Ability

	4	3	2	1
Claim	The claim is easily distinguishable and is well written	The claim is well written, but could use some clarifying.	The claim is not quite clear, and needs developing.	The claim is indistinguishable or doesn't exist.
Grounds	The grounds to your argument are clear, concise, and easy to identify.	The grounds to your argument are easily identified, but need some clarifying.	The grounds to your argument are murky and need some development.	The grounds to your argument aren't displayed or aren't relevant.
Warrant	The warrant is well written, easily identifiable, and connects the claim and grounds of your argument efficiently.	The warrant is clearly identifiable, but could use some clarifying.	The warrant is unclear, but there is something connecting your claims and grounds.	The warrant doesn't connect your claim to your grounds or it isn't easily identifiable.
Backing	Evidence supports the warrant.	Evidence that supports the warrant, but could use some clarifying to show connection as evidence.	Evidence that supports the warrant but the connections need to be clearer.	Evidence that supports the warrant is not identifiable or does not support the warrant.

RESULTS AND DISCUSSION

The effect of learning by using the interactive e-LKPD product for biotechnology materials with the ADI model to improve students' argumentation skills as measured by using *pretest-posttest* with the average results which can be seen in Figure 1. Furthermore, the data from the *pretest-posttest* then tested for normality, homogeneity and *N-Gain*. In addition, the differences between the two groups of experimental and control data were identified using the *independent sample t-test*. was calculated *effect size* to determine the size of the effect of using interactive e-LKPD with the ADI model. The results of the average *pretest* and *posttest* can be seen in Figure 2. And the increase in the level of argumentation ability can be seen in Figure 3 for the experimental group and Figure 3 for the control group.

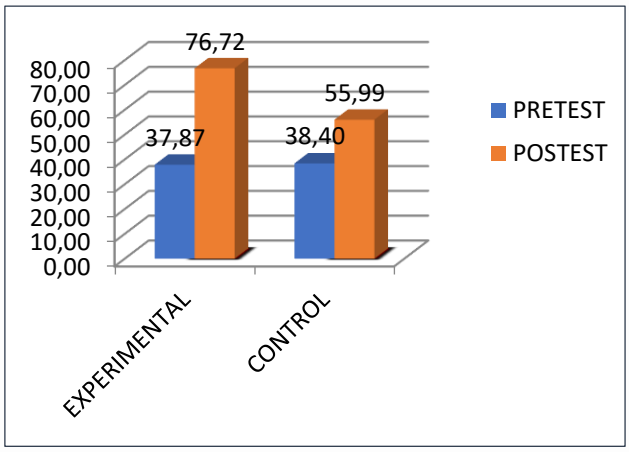

Figure 2. Average of *Pretest* and *Posttest* in the experimental and control groups

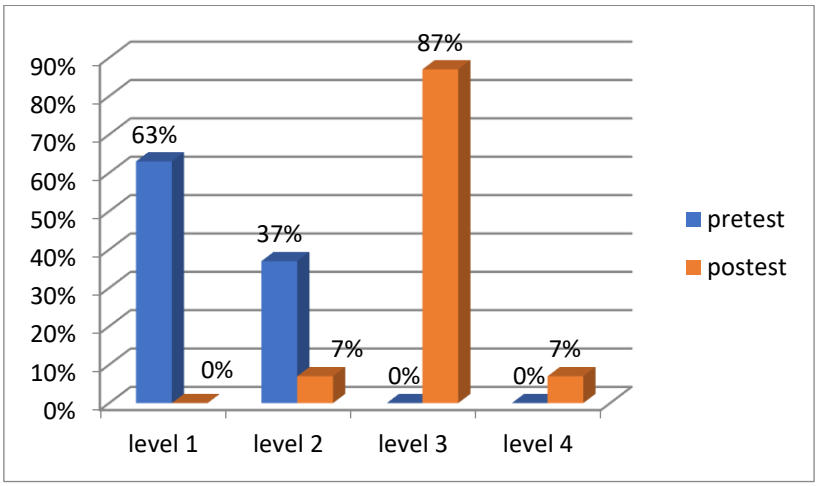

Figure 3. Percentage of Increase in Argumentation Ability of Experimental Group Students

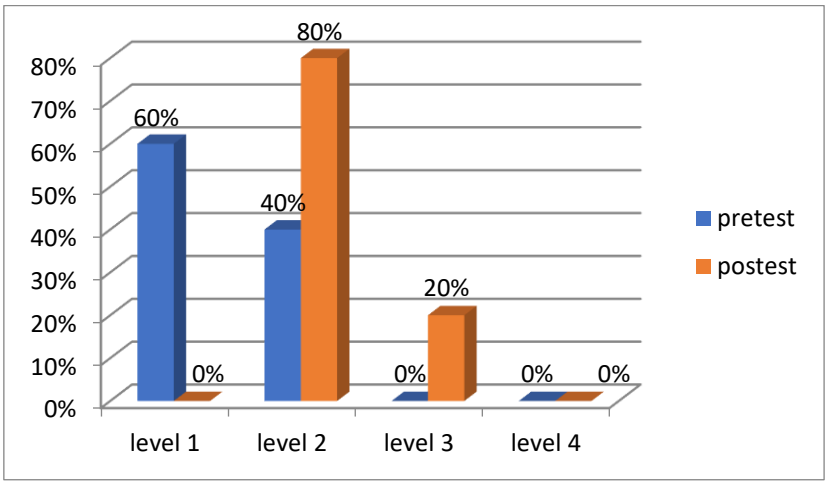

Figure 4. Percentage of Increase in Argumentation Ability of Control group Students

The average value obtained was then analyzed using normality test, homogeneity test, *N Gain*, *T-Test* and *Effect size* to determine the difference between the two groups of data. The results of the analysis test results can be seen in Table 3.

Table 3. Normality Test, Homogeneity Test, Average N-Gain, *t-Test* and *Effect Size*

Class	Normality test		Homogeneity test		$\bar{X}$ N-Gain	Independent Sample t-Test	Effect Size
	Pretest	Postest	Pretest	Postest			
Experiment	0.062	0.141	0.812	0.460	0.63	Sig.(2-tailed) 0,00 < 0.05	0.90
Control	0.109	0.399			0.28		

The implementation of the interactive e-LKPD for biotechnology materials with the ADI model is seen from the increase in argumentation ability which is supported by the ' *pre-post* studentsThe student learning process is carried out with *zoom meetings* and face-to-face activities. *Zoom meetings* are carried out by the teacher in giving appreciation, identifying tasks, collecting data and making tentative arguments with discussion in a *breakout room* according to their respective groups. In the first activity of task identification, students seemed interested and actively involved in learning. Furthermore, the second and third stages, namely collecting data and making tentative arguments, were carried out by grouping students in *breakout room* and the teacher guiding students in managing and analyzing data accompanied by explanations, evidence and reasons. The learning process carried out using *zoom meetings* has problems, namely students have difficulty accessing the internet. This is due to network limitations for students who live in areas where internet networks are difficult.

The fourth activity is the argumentation session, students carry out activities directly giving their arguments in groups. Furthermore, in the fifth stage, namely the preparation of reports, students are asked to make reports based on the results of the investigations that have been carried out. Report generation is typed on a piece of paper. The sixth stage is report review, which is done by collecting reports and then the report is given an assessment by colleagues. The report review process is carried out with instructions and directions by the teacher. After *the review*, the seventh stage is the process of revising the report. In this process students are asked to improve reports on the results of the investigations that have been made and assessed by their peers. Then the last stage, namely the reflective discussion stage at this stage concludes about what they have learned during the investigation. From several stages of the ADI learning model that has been implemented using this interactive e-LKPD biotechnology material.

The implementation of interactive e-LKPD in improving argumentation skills is seen from the results of the *pretest* and *posttest* . In addition, it is also seen from the value of *n-Gain* and *effect size* to find out the difference in the experimental class as a class that treats learning implementation using interactive e-LKPD and the control class uses learning that teachers usually apply. The results of the analysis of the data obtained by the average *pretest* of 37.87 and *posttest* of 76.72 in the experimental class, while the average value of *pretest* and *posttest* in the control class is 38.40. and 55.99. Based on the results of the average *pretest* and *posttest* of the experimental and control classes, it can be seen that the experimental class has a higher increase in value than the control class. In addition test *n-Gain* the experimental class are 0.63 and the control class is 0.28. The results of the acquisition of the average value of the two classes can be concluded that the percentage gain of the experimental class is greater than that of the control class.

Increasing the level of argumentation based on Figure 3 and Figure 4, it is known that the level of argumentation in the experimental class with the percentage of *pretest* level 1 is 63% and level 2 is 37%, while in *posttest* level 2 is 7%, level 2 is 87% and level 4 is 7%. The percentage level in the control class obtained the results of the *pretest*, namely level 1 of 60% and level of 40%. While the *posttest*is level 2 by 80% and level 3 by 20%. Based on this percentage value, it can be concluded that the experimental class students obtained a higher increase, namely level 1 to level 3, compared to control class students who obtained an increase in level from level 1 to level 2. This was due to the application of learning using interactive e-LKPD with ADI model which has stages of learning to train students' argumentation skills. Thus, the application of the ADI model in the experimental class allows students to write *Claims* well using several clarifications (*Claim*), arguments are easily

identified (*Grounds*), can identify clearly and are easily clarified (*Warramt*), and *backing* made has supported *warrants* using several clarification to show evidence (*Backing*). This is in accordance with research conducted by Shofiyatun et al. (2017) that learning by applying the *Argument-Driven Inquiry* (ADI) model has a significant effect on increasing students' argumentation skills. According to (Lismawati et al., 2021) the increase in the level of argumentation in the experimental class has a higher value due to the investigation process carried out using the ADI model. In addition, Putra., et al (2019) also based on their research obtained the results of the BNT test, the difference in the average value of argumentation skills in the ADI model and the guided inquiry model was 33.25 and 10.4, respectively. That is, the achievement of argumentation skills in students using the ADI model is higher.

Test *effect size* obtained a value of 0.90 according to Cohen (2007) *effect size* in the high category. This shows that students' ability to argue is influenced by the implementation of learning using interactive e-LKPD products with biotechnology materials using the ADI model. This is in line with research conducted by Marhamah, Nurlaela & Setiawati (2017) that learning with the ADI model increases the level of argumentation from 1 to level 3. In addition, Nurrahman's research (2018) that students' argumentation skills using the ADI learning model are significantly higher. higher than the average *n-Gain* argumentation ability of students using conventional learning.

CONCLUSION

The results of this study indicate that the implementation *of interactive biotechnology e-LKPD with the Argument-Driven Inquiry model is* effective in improving the argumentation ability of the referred students from the significant difference in the results of the average *pretest-posttest* score which shows the average score of the experimental class is higher than that of the experimental class. control class. The use of interactive e-LKPD with the ADI model has succeeded in boosting the low involvement of students in learning science during the Covid-19 pandemic, so that the increase in thinking and practicing activities during biotechnology learning has changed positively. In addition, science learning programs with interactive e-LKPD have the potential as *scaffolding* in stimulating students' higher-order thinking skills in the digital literacy era.

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