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Critical Thinking Profile of Senior High School Students in terms of Argumentation-Based Learning

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ABSTRACT

This study aims to describe the profile of critical thinking based on argumentation learning in senior high school. This study used a quantitative descriptive study with a subject of 30 students. Subjects were asked to choose the correct answer based on the questionnaire and questions about critical thinking. The results from the questionnaire showed that students' critical thinking skills are 43% in the low category; 47% in the medium category, and 10% students in the high category. As evidenced by the average test results of critical thinking skills, the results obtained are 57.5 in the low category. In the indicator of formulating problems, the results obtained are 57.5 with low critical thinking categories; indicators provide arguments and analyze results 50 with low critical thinking categories; and the result deduction indicator is 60 with medium critical thinking category.Therefore, it can be recommended that the first step to improving critical thinking skills is to conduct argumentation-based learning so that students can convey arguments in physics learning and students' critical thinking skills can increase, so that it's expected to produce competent students according to 21st-century learning.

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INTRODUCTION

One of the higher-order thinking processes is the critical thinking process. Critical thinking skills are one of the abilities high-level thinking that should be developed in school. In line with the aim of the revised 2013 curriculum Prioritizing 21st-century skills as a provision for future life includes character quality skills, literacy, and 4C (Communication, Collaboration, Critical Thinking and Problem Solving, and Creativity and Innovations) (Falchetti et al., 2019). To improve critical thinking skills, a learning model is needed that can make students active in learning (student-centred learning). Active learning is a process of learning to involve student participation active, encouraging students to do meaningful and demanding learning for students to design everything that students do during the lesson. In active learning, students are asked to analyze, synthesize and evaluate during learning which is cognitive activities high level (Akpan et al., 2017). Critical thinking means reflective thinking that focuses on being able to decide on an action that is believed or something to do (Fuad et al., 2017). With active learning, students are expected for remember and understand the learning material more meaningful than using other methods.

An important role in learning is that students can think critically so that students have an open mind. Teachers are required to know how to manage learning so that it is more interesting and the skills needed by students according to developments in the world of education and the openness of globalization which allows information and technology to develop rapidly. Critical thinking is one side of being a critical person where the mind must be open, clear, and based on facts, besides that it has the goal of reflecting one's ability to analyze, synthesize, and evaluate. information (Roksa et al., 2016). Critical thinking is thinking that focuses on entering what is believed to be an action or something do (Fuad et al., 2017). The lack of students' critical thinking skills is due to the teacher's limited ability to develop them, as is known in physics which is known as a difficult lesson with its physics formulas. (Alvionita et al., 2020).

Active participation of students during learning must be facilitated with models of appropriate learning. One of the models of learning that is suitable for use and leads to the active participation of students is the argumentation-based learning model. One of the important goals of argumentation is a basic step to encourage students' critical thinking processes and science literature. Often argumentation is used for scientific debate. Students need strong arguments in learning to strengthen the concepts they have learned. Argumentation also plays an important role in determining how strong science is built (Dorph et al., 2018). The argument is processed and used by someone to analyze information about a topic and then the results of the analysis are communicated (Inch et al., 2015). Thus science learning needs to use argumentation as part of the development of higher order thinking skills (Wibawa & Agustina, 2019).

Physics is knowledge acquired and developed through the scientific method. The discovery and development of knowledge is obtained through this method with systematic steps accompanied by strong evidence, so that this method is closely related to argumentation. From an argument, students can explain and evaluate scientific phenomena based on scientific evidence. According to Bestiantono (2020), Scientific argumentation is important and as a benchmark in learning physics. Teaching to able to train thinking skills in an explicit way and then integrating them into science learning materials can help students to become critical thinkers effectively which in the end leads to complete mastery of students' concepts.

Observations at Kedamean 1 Public High School get that result that 47% of the subjects stated that they had never been trained in argumentation, while 53% of the subjects stated that they had never been trained in argumentation. Subjects who stated that they had been trained in argumentation, namely on topics that did not involve laboratories/experiments. Laboratory activities only end with practicum reports, no arguments / exchange of opinions from the results of practicum. In addition, learning often memorizes formulas rather than emphasizing understanding concepts. Based on these facts, learning activities are focused on aspects of knowledge, so scientific argumentation skills have never been trained. The ability to scientific argument is very important to be applied in learning physics so that students have a good understanding of concepts and logical reasoning about what has been learned, as well as the ability to think critically. (Osborne, 2010).

Based on this background, the purpose of this research is to find out the profile of students' critical thinking skills in physics lessons through questionnaires and critical thinking skills tests. To be able to measure students' critical thinking skills, a teacher must know the indicators of students being said to be critical thinking. Critical thinking indicators developed by the Intercollege Committee on Critical Thinking, which include: 1) formulating problems and hypotheses, 2) selecting information and data to solve problems. , 3) recognize assumptions, and 4) draw conclusions and take action. Meanwhile, according to Ennis (2011), the indicators of critical thinking ability are formulating problems, providing arguments, deduction, induction, evaluation, and being able to make decisions. From some critical thinking indicators above, in the critical thinking skill test in physics, Ennis uses critical thinking indicators, namely formulating problems, giving arguments, analyzing, and doing deductions.

RESEARCH METHOD

Types of Research

Quantitative descriptive method used in this study. The selection of the quantitative descriptive method was based on the aim of the researcher who wanted to know in depth about the profile of students' critical thinking skills on the topic of physics, class XI MIPA at Senior High School 1 Kedamean. The data was obtained from the student's work form of critical thinking skills in the

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questionnaires and tests, then the researchers conducted interviews with teacher to dig up information about the subject's learning.

Research Variable

The variables measured were critical thinking skills through questionnaires and tests by the indicators of critical thinking skills according to Ennis, namely formulating problems, giving arguments, deduction, induction, evaluation, and being able to make decisions. Each question in the questionnaire and test has a score of 1-4 respectively, using an assessment rubric for critical thinking. The scores obtained through analysis and tests shows the level of critical thinking skills so that the critical thinking of student profile in senior high school can be defined.

Population and Sample

This research was conducted in June 2022. The students of class XI MIPA is the population in this study, students even semester of the academic year 2021/2022 at Senior High School 1 Kedamean. The sample was taken using the Cluster Random Sampling technique, namely the students of Class XI MIPA 4 at Senior High School 1 Kedamean, totalling 30 students.

Research Instruments

The instrument used in this study is a questionnaire and test. There are 20 research statements related to the topic in the questionnaire and there are 3 questions on critical thinking on physics matter. The research instrument used refers to Ennis' research, indicators of critical thinking skills are formulating problems, giving arguments, deductions, induction, evaluating, and being able to make decisions. From a number of critical thinking indicators above, in this study 5 critical thinking indicators were set, namely formulating problems, providing arguments, analyzing, evaluating, and deciding. This research instrument was then validated by two education experts, this instrument is declared valid and reliable.

Data Analysis Technique

Data obtained from various sources, namely questionnaires, tests, and interviews were reviewed, and then data reduction was carried out. Interviews were used to obtain more in-depth information about information (which was not contained in students' written answers) regarding the learning process and students' critical thinking.

Furthermore, the research instrument that has been done by students is analyzed descriptively quantitatively in the form of percentages. The results of students' answers were analyzed by referring to the critical thinking scoring guidelines according to indicator critical thinking. To find out students' thinking skills, can be seen from the following percentage values (Susilowati et al., 2017).

$$Percentage\ Value = \frac{Gain\ Score}{Maximum\ Score}\ x\ 100\%$$

The results of calculating the percentage of critical thinking and its categories can be seen in Table 1.

Table 1. Percentage category of critical thinking skills

Value Interval (%)	Category
81,25 < X ≤ 100	Very High
71,50 < X ≤ 81,25	High
62,50 < X ≤ 71,50	Medium
43,75 < X ≤ 62,50	Low
0 < X ≤ 43,75	Very Low

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Students are given a questionnaire of 20 questions that include indicators of Critical Thinking (Ennis, 2011). The indicators of critical thinking according to Ennis include inducing and considering the results of induction; considering whether the source is trustworthy or not; asking and answering questions; observing and considering the results of observations; and defining terms and considering a definition (Ennis, 2011).

In the statements in the questionnaire, there are positive and negative statements. The calculation of the score of each statement in the questionnaire uses a Likert Scale in Table 2.

Table 2. Rating of likert scale

	Rating of Skala Likert			
Statement	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**
Positive	4	3	2	1
Negative	1	2	3	4

(Riduwan, 2012)

The last step in analyzing the data is the conclusion, the results obtained from the research objective are to determine the profile of students' critical thinking abilities.

RESULTS AND DISCUSSIONS

Results of Student Response by Questionnaire

To find out the critical thinking profile of students, they were asked to answer the statements in the questionnaire by the physics lessons at school using indicators of critical thinking skills. This response amounted to 20 statements selected with responses strongly disagreed, disagreed, agreed and strongly agreed represented by a scale of 1 to 4.

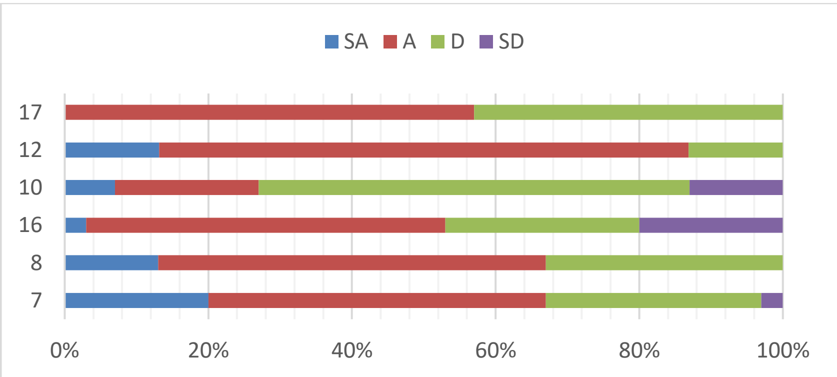

Figure 1. The results of student responses to question number indicator 1 induce and consider the results of the induction.

Note:

SD = Strongly Disagree
D = Disagree
SA = Strongly Agree
A = Agree
7 = By carrying out the practicum, I can predict the events that will appear in the process of implementing the practicum
8 = I can't predict the events that will arise in the process of implementing the practicum
16 = I can understand events in physics that are presented through learning videos during the learning process
10 = In my opinion, assembling tools in practice cannot train skills
12 = I can't assemble my own practical tools without the help of my friends
17 = I am able to make inferences based on precisely observed physical events

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The first critical thinking indicator has three sub indicators. The first sub-indicator is reflected in Figure 1 through statements 7, 8 and 16. Statement no. 7 and 8 are negative statements which explain that new students can predict what will happen to an incident after doing practicum. From the results of student responses, it was found that they agreed more with the statement. This shows that most of them have not been able to carry out the hypothesis, whereas in statement 16 which is a positive statement, it can be seen in Figure 1 that students as many as 3% strongly agree and 50% agree. This shows that more than 50% of students agree that they will be able to carry out a hypothesis if it is shown in a visual form, namely in the form of a video of phenomena. For the second sub-indicator regarding designing an experiment, it can be seen in Figure 1, statements 10 and 12. Based on the results of the responses to statement no. 10, it is known that most do not agree with the negative statement that designing practicum tools cannot improve skills. While in statement 12 they confirmed that as many as 13% of students strongly agreed 73% of students agreed that they could not assemble the tool without the help of their friends. This shows that students actually need groups to design experiments. The third sub-indicator regarding expressing conclusions can be seen in Figure 1 statement 17 that most students have been able to express conclusions.

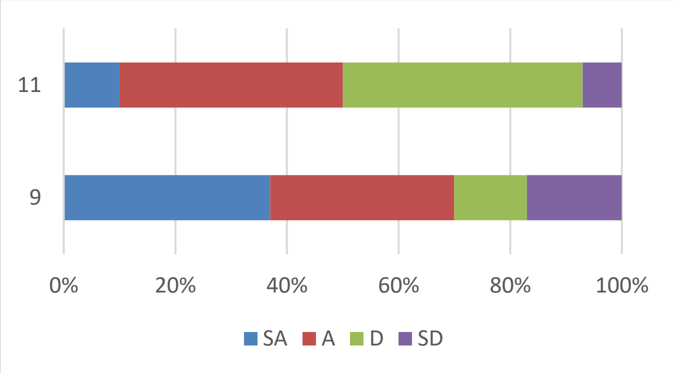

Figure 2. The results of student responses to indicator 2 questionnaire questions considering whether the source can be trusted or not

Note:

9 = I think an experiment should be planned by preparing the necessary tools and materials

11 = In my opinion, there is no need for practicum well planned in order to get results according to existing facts and concepts

Based on student responses to the second indicator shown in Figure 2, it is known that most students agree that choosing tools, materials in designing experimental procedures is able to show appropriate and reliable results.

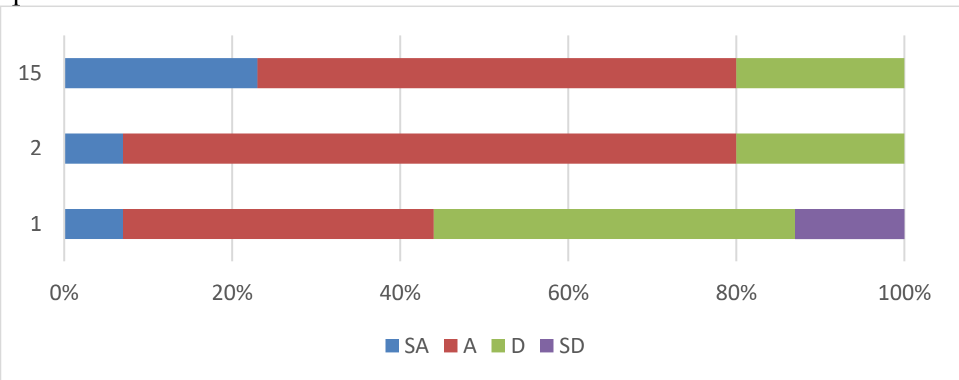

Figure 3. Results of student responses to indicator 3 questionnaire questions asking and answering simple questions

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Note:
1 = I can easily explain physics material that I encounter in everyday life
2 = I am not able to understand the relationship between physics material and natural events encountered in everyday life
15 = I am not able to distinguish any physical quantities related to events in everyday life

Based on the third indicator regarding asking and answering simple questions as shown in Figure 3, it is known that in general they have not been able to explain physics concepts and quantities in everyday life.

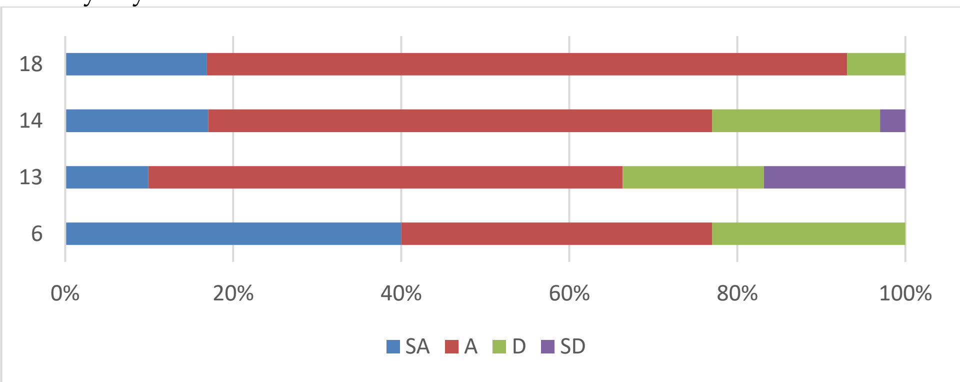

Figure 4. The results of student responses to indicator 4 questionnaire questions observing and considering the results of observations

Note:
6 = I need to do a practicum to prove whether the physics material is true or in accordance with reality.
13 = In my opinion, making a table in the practicum is very necessary because it will make it easier to record every observation into the table
14 = With practicum I can observe the symptoms that occur during the practicum.
18 = I like it if the teacher carries out physics learning by doing practicum because it is useful in the application of everyday life

Based on Figure 4 regarding student responses to statements no. 6, 13, 14, and 18 regarding in observing and considering are known that in general students feel the need for practicum to observe. Most of them also like it when the teacher provides physics lessons with practicums to apply physics concepts in everyday life.

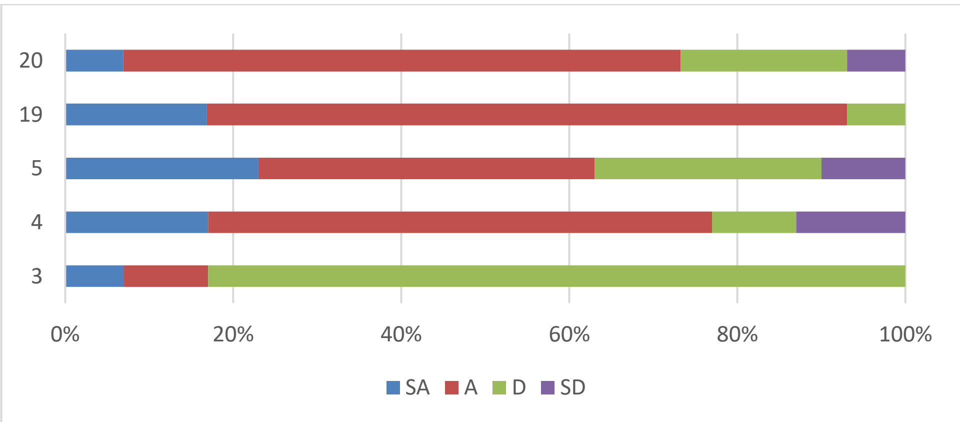

Figure 5. Results of student responses to indicator 5 questionnaire questions defining terms and considering a definition

Note:
3 = The learning method used by the teacher makes it easy for me to understand the material being taught, and able to explain the material
4 = I understand more about physics material after doing practicum.
5 = I am not able to exchange opinions with friends when discussing physics material.
19 = It's easier for me to learn physics if I know how to apply it in everyday life
20 = It is easier for me to understand the concept of physics than the calculation of formulas in physics

Based on statements 3 and 5 in Figure 5 regarding student responses regarding the learning methods provided by the teacher so far, in general they have not been able to explain again and exchange opinions with friends regarding the physics material being studied. In statement 4 it is known that the student 17% strongly agree and 60% agree, so they will be better able to understand physics material by using practicum. In statements 19 and 20 they generally agree that they will be more able to learn physics by associating physics concepts in everyday life than learning physics using formulas. Therefore, the inability of students to explain the physics material from the learning that is done, shows that students have not fulfilled the fifth critical thinking indicator, namely to define terms and consider a definition.

Based on the results of a questionnaire (20 research questions) by students of senior high school related to critical thinking skills. The following results are obtained, Table 3.

Table 3. Students' critical thinking ability level

Value Interval (%)	Many Students	Percentage	Category
$71{,}50 < X \leq 81{,}25$	3	10%	High
$62{,}50 < X \leq 71{,}50$	14	47%	Medium
$43{,}75 < X \leq 62{,}50$	13	43%	Low

From the table, we can see that the level of critical thinking skills through a questionnaire, the students with a range of 43.75-62.50 in the low category was 13 students or 43%. Then the number of students who obtained a range of 62.50-71.50 in the medium category was 14 students or 47%. Furthermore, for the range of 71.50-81.25 in the high category as many as 3 students or 10%. According to (Adiputri, 2015), reality shows that the competence of students in the cognitive field is still lacking, meaning that the low cognitive competence of students is due to the lack of critical thinking skills by students. Factors causing the above results include the lack of efficient learning in schools such as the use of inappropriate learning models or learning activities that focus on teachers as a learning centre. Mart (2013) states that good teachers know that their role is to make students active in learning. It is suggested that teachers increase students' intrinsic motivation in student-centered classes, so that it can be useful for developing student competence.

Students Critical Thinking Skills

This research was conducted at Senior High School 1 Kedamean, with the subjects in this study being students of class XI MIPA 4 consisting of 30 students who took the critical thinking ability test. This research was conducted to determine students' Critical Thinking Ability on the topic of physics. The critical thinking ability question instrument consists of 3 questions that represent critical thinking indicators. From a number of critical thinking indicators, in the test of critical thinking skills on the topic of physics, Ennis uses critical thinking indicators, namely Problem No.1 with indicators for formulating problems; Question No.2. with indicators for analyzing arguments; and Problem No. 3 with deduction indicators.

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Data on the critical thinking ability of students of class XI MIPA-4 Senior High School 1 Kedamean, it is known that the average critical thinking ability on the topic of physics is at a low criterion, namely 57.5. The average subject's work can determine the concept used to solve the problem and can provide an explanation both in terms of definition and concept linkage, but the subject's average answer is still not able to provide the right reasons for the answers are given / reasons related to what was written. Students seem to still have difficulty in writing unfortunately/justification. Pritasari et al., (2016) find that the most students still often experience difficulties when making reasons or explanations that link a claim put forward with the data provided. Although there are students who can give these reasons, these students have not been able to give the right reasons. Despite the fact that according to Ginanjar et al. (2015) when writing justifications, students only need to explain the relationship between data and claims.

This indicates that the subject lacks the character of reason and overview for critical thinking skills (Ennis, 2011). Based on the results of the questions about critical thinking on physics material using the Ennis indicator, it can be seen in Table 4.

Table 4. Percentage of Students' Critical Thinking Ability

<table>
<tr><th>No</th><th>Critical Thinking Indicator</th><th>Questions</th><th>Percentage (%)</th><th>Category</th></tr>
<tr><td>1</td><td>Formulate the problem</td><td>Every year a hot air balloon festival is held in Europe. All necessary hot air balloons meet the requirements of good flight. One of the requirements is to use a quality heater. The participants are prohibited from using a bad heater because it can be fatal when flying.
Explain the focus of the problem! Give a good reason for the problem presented.</td><td>57,5</td><td>Low</td></tr>
<tr><td>2</td><td>Analyze arguments</td><td>Rina wants to be a professional cook. He then enrolled in a cooking training institute. While cooking food, Rina was asked by her teacher to cover the pot that was being heated. The teacher said that by closing the pot the food would cook quickly.
If it is assumed that gases are ideal, do you agree with this suggestion? Give your reasons.</td><td>50</td><td>Low</td></tr>
<tr><td>3</td><td>Deduction</td><td>A diver dives at several depths (h) below the water surface, with the value of the density of water (ρ) and the acceleration of gravity (g= 10 m/s2) constant, the diver gets hydrostatic pressure as shown in the table.
<table>
<tr><th>No</th><th>Diver</th><th>Depth (meters)</th><th>Hydrostatic Pressure (Pa)</th></tr>
<tr><td>1</td><td>A</td><td>2</td><td>$2,01 \times 10^5$</td></tr>
<tr><td>2</td><td>B</td><td>9</td><td>$9,01 \times 10^5$</td></tr>
<tr><td>3</td><td>C</td><td>4</td><td>$4,01 \times 10^5$</td></tr>
<tr><td>4</td><td>D</td><td>9</td><td>$9,01 \times 10^5$</td></tr>
<tr><td>5</td><td>E</td><td>4</td><td>$4,01 \times 10^5$</td></tr>
</table>
Based on the data presented:
Conclude which diver has the greatest hydrostatic pressure!</td><td>65</td><td>Medium</td></tr>
</table>

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No	Critical Thinking Indicator	Questions	Percentage (%)	Category
		Relate your answer to the hydrostatic pressure equation and make a graph showing the effect of depth (h) on the hydrostatic pressure (Ph) felt by the diver!		

Based on the results of tests that have been carried out by students, for number 1 with indicators for formulating problems, a score of 57.5 is obtained in the low category. Some students are still wrong in answering the test questions. The subject has been able to determine the concept used to solve the problem, but the subject has not been able to provide a good explanation in terms of the relevance of the concept. Critical thinking in this context is the ability of a person to reason to integrate his knowledge to analyze facts, create and defend ideas, and draw conclusions (Ghofur et al., 2016). 10% of subjects can answer the question correctly, that the focus of the problem is the obligation to use a good heat source. This is because using a good heat source will affect the resulting pressure. According to the ideal gas concept, the pressure will increase with increasing temperature. This will cause the hot air balloon to float in the air. However, 53% of the subjects were still unable to provide good explanations in terms of the relevance of the concept, they assumed that the higher the air temperature, the larger the volume of air molecules so that the air pressure was lower. like in a hot air balloon, if the air is hotter it will be lighter because it has a smaller mass per unit volume. 37% of the subjects were able to determine the concept used to solve the problem, but it was still not appropriate in giving reasons for what was written.

In question number 2 with Analysis and Argument indicators, the results are 50 in the low category. Harris et al., (2012) Argument can train students to use their thinking skills. According to Deane & Song, (2014) Arguments have an important role in developing critical thinking patterns and adding an in-depth understanding of an idea. To test students' critical thinking skills, structured questions are designed so that students answer as expected. 70% of the subjects have not been able to connect with what physics concepts are used to solve problems. Students do not relate the reason for the answer to the concept of an ideal gas related to temperature, pressure, and volume. Meanwhile, 30% of the subjects were able to relate the answers to the physics concepts they had learned to solve the problem, that food cooked faster when the pot was closed because the temperature increased which caused the pressure to also increase so that the thermal energy of the particles increased and boiled quickly. However, the lid is given a small hole to make it safer from the danger of an explosion.

In question number 3, the results obtained are that 60% of students can answer correctly, but 40% of students still answer incorrectly. The assumption of the researcher is that the subject who is still wrong in doing the work is that the subject has not been able to read and understand the problem table, because the table that does not have a partner is only diver A, and the subject does not give a reason why diver A is the one with the highest pressure. The subject's answer is not equipped with further analysis or reasons, the subject does not provide a reason for the answer given. This students showed that they still don’t understand what they should do with the problems presented (Eva et al., 2021; Simamora et al., 2017; Wyness & Dalton, 2018), while critical thinking is a person's ability and tendency to make conclusions. based on evidence (Eggen & Kauchak, 2012). In addition, the weakness of answer number 3 is that there are still many students who have not been able to describe the graph of the relationship between the manipulation variable and the response variable from a problem table.

However, in question number 3, that 60% of the subjects answered correctly, that the divers who have the greatest pressure are divers B and D. This can happen because divers B and D are at the deepest depths. In accordance with the hydrostatic pressure equation, the hydrostatic pressure (Ph) is directly proportional to the depth (h), meaning that the greater the value of h, the greater the hydrostatic pressure obtained, and vice versa. Subjects can also prove by drawing a graph of the relationship between depth and hydrostatic pressure to prove which diver has the greatest hydrostatic pressure.

Based on the results obtained, the indicators of critical thinking in formulating problems, providing arguments and analyzing have a low category, this is because the subject has not been able to connect with what physics concepts are used to solve problems and have not been able to provide reasons for what was written. While the indicators of critical thinking do deduction results in good categories, the subject can understand the data by completing using relevant theories/concepts that have been studied. In line with research Sulardi et al., (2015) stated that critical thinking skills are needed by students because with these skills, the ability to master learning concepts obtained by students is better, but in fact, students' critical thinking skills are still low. Continous critical thinking test practice needed to be done so that they found it easier to answer the critical thinking questions (Sari et al., 2021).

Based on the achievement of learning outcomes in the Indonesian Education Report Card (2022) in East Java province for literacy skills, namely most students have reached the minimum competency limit for reading literacy, but efforts are needed to encourage more students to become proficient. As for numeracy skills, the results are below the minimum competency, meaning that less than 50% of students have reached the minimum competency limit for numeracy. Assessment of numeracy skills is carried out to measure students' ability to use concepts, procedures, and facts to solve relevant daily problems (Maryuliana et al., 2016). In this case, the question of critical thinking uses problems in everyday life, which then the subject solves the problem associated with the concept of physics. In line with that, the Kemendikbud, (2020) states that cognitive processes and context are the basis for assessing numeracy skills. Based on the cognitive process, the assessment of numeracy skills is related to the process of understanding the concept, and then understanding the concept is used to reason in solving problems.

Learning Science, one of which is Physics, requires high critical thinking skills, with the hope that students can develop their thinking skills to become someone who can solve problems well so that they can produce human resources (HR) who have the skills needed in the world of work in the future. Critical thinking skills are very necessary in life. This is supported by the fact that education in the 21st century requires competent human resources directed at learning and innovation skills, which include critical thinking skills, decision-making abilities, creative thinking skills, responsibility, and the ability to learn independently (Griffin & Care, 2015).

The level of a person's critical thinking skills is strongly influenced by his learning experience. That is, if during the learning process that has been experienced by a person is often stimulated to carry out critical thinking activities, then he will have a good critical thinking skill development profile. This is by what was expressed by Stone et al. (2017) that the level of cognitive development turns out to be a person's initial capital to be able to carry out critical thinking activities. The results of Rodzalan & Saat (2015) research on critical thinking conclude that critical thinking can be achieved when students make their own decisions in learning. In addition, according to Conklin & Manfro (2012) critical thinking skills have the advantage of being able to support students' academic achievement.

Interview Results about Argumentation-Based Learning

Interviews were conducted with physics teachers about physics learning in schools related to arguments and laboratory activities, such as the following conversation excerpt.

> What learning model do you usually apply to the physics learning process? Have you ever applied learning with an Argumentation-based learning model? ***–"depending on which one is simpler, adjusting the subject matter that is easily understood by students.***

Learning using argumentation has been carried out, but it is only a debate between students regarding the topic/phenomenon being debated".

How active are students when the physics learning process takes place? Have students ever been trained to argue in physics lessons? ***-"the activeness of students in the learning process is quite active, meaning that when the teacher explains the material and the teacher gives questions, students will answer the teacher's questions. However, sometimes students are also quite passive in the learning process if they feel that the physics material is quite difficult for them. For arguments in physics learning, at that time students argued about the flat earth / round earth. In the argumentation process, they only argue based on what they believe, not based on data/theory.***

Have students ever made arguments related to the experimental data that has been done? ***–" in the learning process until now when students finish doing practicum, students only gave presentations to convey the results of the experiments that had been carried out."*** Have students never been trained to argue based on scientific argumentation indicators such as claims, data, warrants and backing? ***–"have never been trained, and students have never known scientific argumentation / how to argue in determining a claim that is supported by data and supporting theories / reasons".***

The results of interviews with physics teachers stated that physics learning in schools uses an inquiry learning model that involves laboratory activities. In laboratory activities, students only complete a practicum report in groups. However, to communicate the results of the practicum that has been carried out, only one group has done it without exchanging opinions with other students regarding the results of the practicum that has been done. In physics learning, there is no activity to argue about the findings/results they get from practicum activities.

According to Zivkovic (2016), learning in the 21st century requires students to face real-world problems that involve them in critical thinking skills. Critical thinking skills as one of these demands need to be trained and developed. One way to train and improve critical thinking skills is through argumentation. In addition, scientific argumentation skills can equip students to provide explanations for physics phenomena that occur in everyday life based on physics concepts/theories (Osborne, 2010). In line with Kadayifci et al. (2012), learning that uses argumentation can make a significant difference to critical thinking skills. Arguments or opinions can train students in using their thinking skills. Argumentation according to Deane & Song (2014) has an important role in developing critical thinking patterns and adding a deep understanding of an idea.

The involvement of teachers can create a warm and caring classroom community with lots of practice is a supportive motivation, and always shows good planning resulting in student work reaching a high level, in learning students are encouraged to be actively involved in discovering their knowledge by various activities such as observing, experimenting, and arguing. Students are encouraged to learn by being actively involved through concepts and principles, and teachers encourage students to have experiences and conduct experiments and communicate experimental results that enable them to find concepts for themselves. Another supporting research is research conducted by Bathgate et al. (2015) which states that the ability of high school students to make arguments in science has an impact on learning, including one of them, namely critical thinking, and according to Fadilah et al. (2020) that Argument-Driven Inquiry (ADI) model with a Contextual Approach is proven to be feasible and effective for improving critical thinking skills.

CONCLUSION

From the research, it was found that the critical thinking ability of 43% of students was in a low category; 47% of students in the medium category, and 10% of students in the high category. As evidenced by the average test results for critical thinking skills, the results obtained are 57.5 in the low category. In the indicator of formulating the problem, the results obtained are 57.5 with low critical thinking category; indicators provide arguments and analyze the results obtained 50 with low critical thinking category, and deduction indicators obtained 60 results with medium critical thinking category. Therefore, it can be recommended that the first step to improving critical thinking skills is to conduct argumentation-based learning so that students can convey arguments in physics learning and can improve students' critical thinking so that it is expected to produce competent students in their fields in 21-century learning.

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