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PROFILE OF CRITICAL THINKING SKILLS OF JUNIOR HIGH SCHOOL STUDENTS ON THE TOPIC OF BIOTECHNOLOGY

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Abstract
This study aims to obtain information related to the profile of critical thinking skills of junior high school students on the topic of biotechnology. The method used was survey method. The research subjects were 113 ninth grade students in one of the public junior high schools in Bandung City. The research subjects were determined using convenience sampling, which is a sampling technique used by researchers because the selected participants are available and have readiness. The research data were collected from the Inch critical thinking test using validated questions. The test instrument includes 22 questions that represent 8 elements of Inch-type critical thinking skills adapted from Paul and Elder. The data obtained in this study were processed with descriptive analysis techniques. The results showed that the profile of critical thinking skills classically was 2.65% in the very low category, 9.74% in the low category, 38.05% in the medium category, 31.86% in the high category and 17.70% in the very high category. Inch students' critical thinking achievement is 60.46%. The conclusion based on the results of data analysis shows that grade IX students can still be improved through learning activities.
Keywords: Critical thinking skills, junior high school students, biotechnology topic

INTRODUCTION

Education according to Law No. 20 of 2003 regarding the national education system, it is explained as a conscious and planned effort to create a learning atmosphere and learning process so that students actively and optimally utilize their potential. (Depdiknas, 2003) Learning is the process of student interaction with teachers and learning resources in a learning environment. Learning needed in the 21st century includes four competencies that can be developed by students, namely critical thinking and problem solving, creativity and innovation, collaboration and communication. This learning implements a teacher-centered learning approach to student-centered learning based on the applicable curriculum.

The government continues to review and revise the curriculum on an ongoing basis to be in line with changing times, one of which is the implementation of an independent curriculum (Kemendikbud, 2024). The foundation in designing an independent curriculum is the philosophy of independent learning. The implementation of independent learning applies to all subjects including Natural Science (IPA) subjects. Student-centered science learning makes the teacher's role as a facilitator based on two main elements, namely science understanding and process skills as found in the junior high school science learning outcomes (Kemendikbudristek BSKAP, 2022). Students at the junior high school level are

included in phase D which carries out science learning to train scientific attitudes including high curiosity, critical thinking, analytical, open, honest, responsible, objective, not easily discouraged, diligent, solutive, systematic, and able to draw the right conclusions (Kemendikbudristek BSKAP, 2022). This is in line with the concept of implementing deep learning in junior high school / MTs or equivalent to strengthen conceptual understanding, critical thinking skills and communication skills (Hidayat & Kosasih, 2019).

Based on the PISA (Program for International Student Assessment) results for 2022, it states that Indonesia has increased its ranking, but the average score on science literacy has decreased by 13 points (OECD, 2023), one of which illustrates the low critical thinking skills of students in Indonesia. This is in line with previous research which shows that the majority of the Indonesian population has low critical thinking skills (Fitriani et al., 2020; Alfiyanti et al., 2020; Yulianis & Suryanti, 2023). Critical thinking skills need to be provided to students. Griffin et al. (2018) state critical thinking skills as one of the skills needed in the 21st century as follows.“These skills include creativity, critical thinking and problem solving, collaborative skills, information technology skills, and new forms of literacy, and and being aware social, cultural, and metacognitive awareness.”

Critical thinking skills can be developed in science lessons on various materials or topics studied. One of the materials studied is biotechnology with the learning outcomes of students identifying the inheritance of traits and the application of biotechnology in everyday life. This material is studied by students in one of the public junior high schools in Bandung City in grade IX using strategies, models, and methods based on those prepared by the teacher. Critical thinking can not only be developed in learning, but must also be supported by evaluations that reflect critical thinking (Rusyati et al., 2013).

Assessment is an activity that is inseparable from learning activities. Assessment is carried out to obtain authentic evidence/data or a basis for consideration of the achievement of learning objectives (Anggraena et al., 2022). There are various forms of assessment that can be developed by teachers. The assessment that is prepared is adjusted to the purpose of the assessment, one of which is to measure the achievement of students' critical thinking skills. Assessments developed to measure students' critical thinking skills can be based on the eight elements of critical thinking Inch et al. (2006). According to Paul and Elder (Inch et al., 2006), there are eight elements of critical thinking which consist of several sub-elements of critical thinking. The eight elements are purpose, question at issue, assumptions, point of view, information, concepts, interpretation and inference, and implication and concequences.

Based on this background, research is needed to obtain information about the critical thinking skills Inch possessed by ninth grade students through completing questions that contain critical thinking skills for the topic of biotechnology. The problem formulations developed in this study are as follows. What is the profile of critical thinking skills of junior high school students on the topic of biotechnology?

METHOD

The research method used is the survey method, which is research that can help researchers answer three types of questions, namely descriptive questions (for example, related to percentages, questions about relationships between variables and questions about predictive relationships between variables over time (Creswell & Creswell, 2018). The research subjects were 113 ninth grade students in one of the public junior high schools in Bandung City. The research subjects were determined using convenience sampling, which is a sampling technique used by researchers because the selected participants are available and

have readiness. The research subjects included 4 classes with the number of each class varying.
The instrument used was multiple choice critical thinking questions with four answer options that have been validated based on eight elements of critical thinking adopted from Inch et al (2006). Inch's critical thinking questions were delivered to grade IX students via google link form after studying the topic of biotechnology in class using learning methods that integrate theory and practice.
The data obtained is the student's score in answering the questions. The steps in data processing are as follows.

1. Scoring each student's answer based on the available answer key
2. Calculating the score obtained by each student
3. Calculating the average value of student thinking using the following formula.

$$Average\ value = \frac{\Sigma\ score\ of\ all\ students}{\Sigma\ total\ number\ of\ students}$$

4. Calculating the score into percentage form

$$Student\ score\ (\%) = \frac{\Sigma\ \ correct\ answer\ to\ the\ question}{\Sigma\ total\ questions}$$

5. Calculating the percentage of achievement of critical thinking skills on each element based on Inch (2006)

$$Thinking\ skill\ every\ element\ (\%) = \frac{\Sigma\ \ correct\ answers\ of\ all\ students}{\Sigma total\ student}$$

RESULTS AND DISCUSSIONS

The topic used in this research is Biotechnology. This topic is included in the science understanding element contained in phase D science learning outcomes, namely students identify the inheritance of traits and the application of biotechnology in everyday life. Biotechnology is generally delivered in grade IX of junior high school using various methods.Based on the characteristics of science subjects that state in the element of understanding science, critical reasoning in understanding content coverage is what is expected of students (Kemendikbudristek BSKAP, 2022). Following up on this, critical thinking skills need to be provided to students in learning activities. To measure the achievement of students' critical thinking, one of them is through assessment.

The questions used in this study are based on the eight elements of critical thinking Inch et al. (2006). The eight elements are purpose, question at issue, assumptions, point of view, information, concepts, interpretation and inference, and implications and concequences. The critical thinking skills questions used in this study have been validated.

1. Profile of students' critical thinking skills based on analysis of scores obtained by students

The achievement of inch critical thinking in one of the public junior high schools in Bandung City based on the scores owned by students is in the very low category with a percentage of 2.65%, low category with a percentage of 9.74%, moderate with a percentage of 38.05%, high category with a percentage of 31.86% and high category with a percentage of 17.7%. The percentage of critical thinking inches in the moderate category has the highest achievement with student scores between 41-60, followed by the high category with student scores between 61-80 while the lowest percentage is in the very low category with student scores between 0-20.

Table 1 Students' critical thinking skills Based on Student Score Percentage

No	Category	f	Persentase
1	Very low	3	2.65%
2	Low	11	9.74%
3	Moderate	43	38.05%
4	High	36	31.86%
5	Very High	20	17.70%
Total		100	100%

2. Profile of students' critical thinking skills based on Inch (2006)

Inch critical thinking achievement of public junior high school students in Bandung City is 60.46%. These results indicate that the achievement of critical thinking Inch public junior high school students in Bandung City is in the high category (Arikunto, 2013). This achievement is obtained from the contribution of Inch's critical thinking elements based on the largest to smallest number of occurrences, namely point of view 69.03%, elements of implication and concequences 65.49%, interpretation and inference 64.61%, information 62.83%, purpose 62.61%, concepts 60.47%, question at issue 56.64% and assumptions 42.04%. So the element that appeared the most was point of view (69.03%) and the element that appeared the least was assumptions (42.04%).

The achievement of critical thinking skills in each inch element can be visualized in Figure 1.

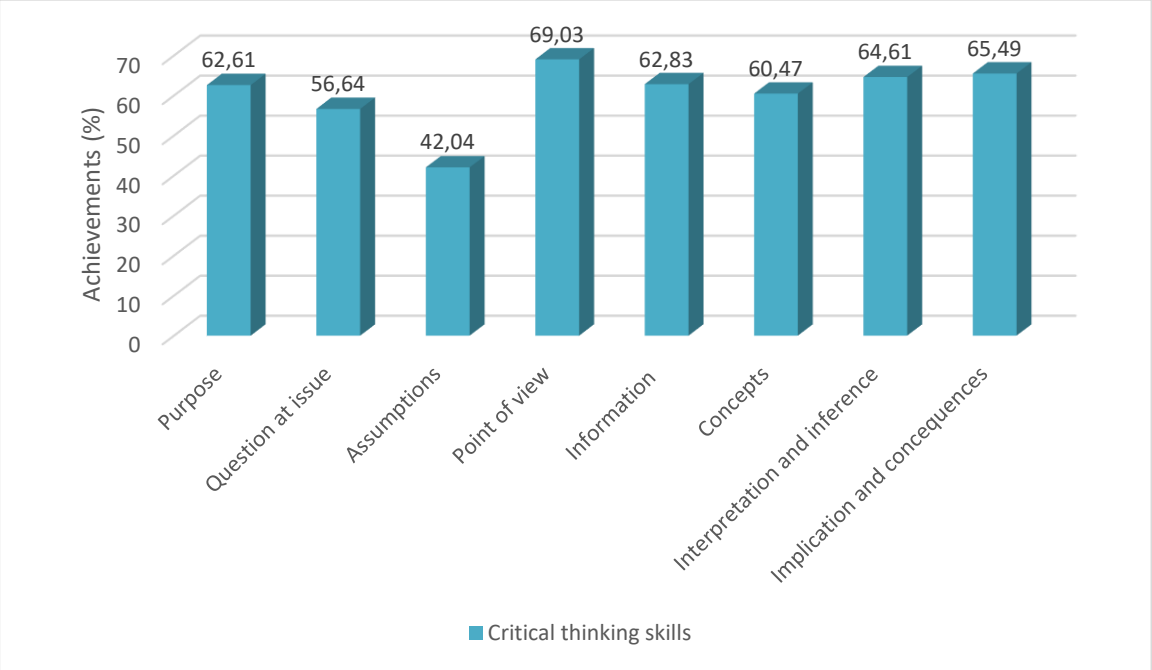

Figure 1. Achievement of Students' Inch Elemen Critical Thinking Skills

Each inch element includes several sub-elements that contribute to the achievement of critical thinking in each element. Based on the analysis of the scores of students who answered correctly on each sub-element, the percentage of critical thinking achievement can be visualized in table 2.

Table 2. Students' critical thinking skills based on inch element

No	Elemen	Sub Elemen	Percentage (%)	Percentage in 1 element (%)
1	Purpose	State the objective clearly	64.6	62.61
		Distinguishing the main goal from other goals	61.95	
		Stating the goal according to the target	49.56	
		State significant and realistic goals	74.33	
2	Question at issue	Ask questions in several ways to clarify the meaning and scope of the problem	40.7	56.64
		State the sub question	61.95	
		Identifying problem questions 1) Question has only one correct answer 2) The question can be answered with multiple points of view	67.26	
3	Assumptions	Identify assumptions and determine if they are correct	50.44	42.04
		Consider that the proposed assumptions may shape the point of view on the problem	33.63	
4	Point of view	Identifying point of view	82.3	69.03
		Identify the strengths and weaknesses of viewpoints	59.29	
		Be fair in assessing all points of view	65.49	
5	Information	Expressing support based on data	56.63	62.83
		Search for information that opposes and supports the argument	55.75	

No	Elemen	Sub Elemen	Percentage (%)	Percentage in 1 element (%)
		Uses information that is clear, accurate and relevant to the problem question	69.02	
		Gather enough information	69.91	
6	Concepts	Identifies key concepts and states them clearly	55.75	60.47
		States an alternative concept or alternative concept definition	56.63	
		Use concepts carefully and thoroughly	69.03	
7	Interpretation and inference	Conclude based on evidence	74.34	64.61
		Identify assumptions that may lead to conclusions	54.87	
8	Implication and concequences	State positive and negative implications	65.49	65.49

Based on the achievement of critical thinking inch, the highest percentage is in the sub-element identifying point of view 82.3% and the lowest percentage is in the sub-element consider that the proposed assumptions may shape the point of view on the problem 33.63%. This correlates with the highest critical thinking achievement on the point of view 69.03% and the lowest critical thinking achievement on the assumptions sub-element 42.04%.

The critical thinking element of the goal inch includes four sub-elements, namely stating goals clearly, distinguishing the main goal from other goals, stating goals according to the target and stating significant and realistic goals. The sub-element that has the lowest percentage of critical thinking achievement and is below the value of critical thinking skills of ninth grade students is stating objectives according to the target of 49.56%. Based on the characteristics of the questions given to students, students are asked to determine the purpose of giving yeast to sticky tape after being given a stimulus regarding the steps of making sticky tape. Based on the data on the achievement of critical thinking in these sub-elements, most students have not been able to determine the purpose of giving yeast to glutinous rice tape. Although in the learning activities there is the possibility of practicing making the tape.

The critical thinking element inch questions to the problem includes three sub-elements with sub-elements that have the lowest percentage of critical thinking achievement and are below the value of students' critical thinking skills, namely asking questions in several ways to explain the meaning and scope of the problem 40.7%. Based on the characteristics of the problem given, namely students are asked to look at a diagram of the process of making Dolly sheep, most students have not been able to determine statements that ask for explanations and are in accordance with the scope of the problem.

The critical thinking element inch assumptions with two sub-elements that have a low percentage of category achievement, namely identifying assumptions and determining whether the assumptions are correct 50.44% and considering that the assumptions proposed can form a point of view on the problem 33.36%. These results show that most students have not been able to determine the assumptions contained in the problem. Referring to the data, it can be a feedback for teachers to always supply students' assumption skills through learning. This is in line with previous research that students' ability to assume needs to be trained (Lubis & Syahputri, 2022).

The critical thinking element Inch point of view has the highest critical thinking achievement of all Inch elements. The point of view element consists of three sub-elements with the highest achievement in the sub-element of identifying points of view 82.3%. Among the three sub-elements, there is still the lowest critical thinking achievement among other sub-elements, namely identifying the strengths and weaknesses of the point of view of 59.29%. Based on the characteristics of the questions given, namely identifying points of view by interpreting various statements contained in colored comics.

Inch information critical thinking element includes four sub-elements namely stating support based on data 56.63%, looking for information that opposes and supports arguments 55.75%, using information that is clear, accurate, and relevant to the problem question 69.02% and collecting sufficient information 69.91%. Based on the critical thinking questions given, the two sub-elements that have the lowest critical thinking achievement have a stimulus in the form of statements contained in colored comics. Although Cheesman's research (2006) revealed that comics found in magazines or newspapers can help students to understand a concept and can stimulate critical thinking, it is still balanced with student literacy.

Inch concept critical thinking element includes three sub-elements, namely identifying key concepts and stating clearly 55.75%, stating alternative concepts or alternative concept definitions 56.63% and using concepts carefully and thoroughly 69.03%. The second sub-element of Inch's critical thinking based on the characteristics of the questions given is to interpret the information contained in the excerpts of articles related to tissue culture and the information contained in the table regarding fermented products associated with key concepts and alternative concepts. This information can be feedback for teachers in equipping students both in learning activities to analyze articles or analyze data in the form of tables, diagrams associated with the concepts to be learned.

Inch's critical thinking element of interpretation and drawing conclusions includes two sub-elements, namely concluding based on evidence 74.34% and identifying assumptions that can lead to conclusions 54.87%. Inch's lowest critical thinking achievement is in the sub-element of identifying assumptions that can lead to conclusions. This is in line with the achievement of the lowest critical thinking in the assumption element. Based on the characteristics of the problem in the sub-element, students interpret the insulin hormone production diagram. Referring to other sub-element questions, students' skills in interpreting images, diagrams or tabular data need to be supplied and practiced in the learning process.

The critical thinking element Inch implications and consequences includes one sub-element of the validated problem, namely the sub-element of stating positive and negative implications 65.49%. Based on the characteristics of the questions in this sub-element, some students already understand the negative implications of the discourse given.

Referring to the types of stimulus for Inch critical thinking questions on the topic of biotechnology, the skills that need to be improved are interpreting tabular data, diagrams

and articles, information contained in color comics. The type of stimulus given in the form of video analysis, provides high critical thinking achievement. This is in accordance with research conducted by Ridwan et al. (2000) that video-based learning media can be one of the learning media utilized by teachers as an effort to convey learning content to be delivered in the learning process. Through video, it can reduce the obstacles that students often experience in the learning process.

As previously stated, the results of this study are the achievement of critical thinking Inch in one of the Bandung City Public Junior High Schools which is 60.46% as presented in Figure 2.

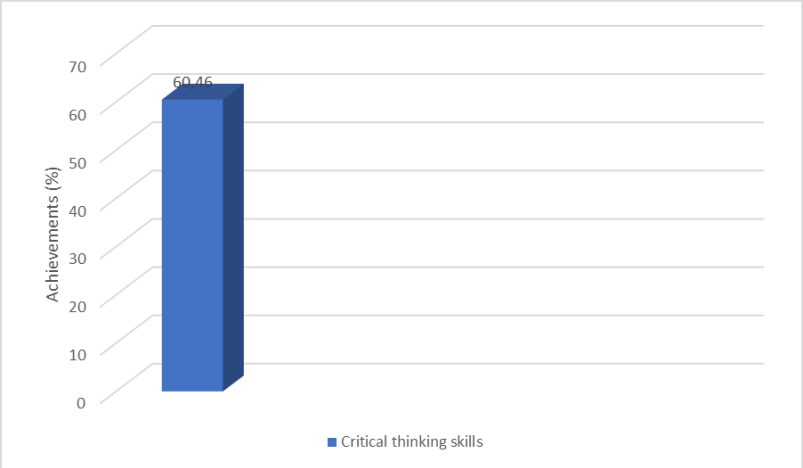

Figure 2. Students' critical thinking achievement

The research that has been conducted shows the profile of students' critical thinking skills based on the score answered correctly by students has an average score of 60.86 while the profile of critical thinking inch is 60.46% in public junior high schools in Bandung City on the topic of biotechnology. This research can provide an overview of students' critical thinking skills that need to be supplied and improved in students, especially in the elements of assumptions and asking questions. Although this research was only conducted on one biotechnology topic, it can at least provide an overview and become feedback for teachers to develop critical thinking skills in classroom learning activities by applying various models, strategies, methods to the assessment stage.

CONCLUSION

Based on the results of research related to the profile of critical thinking skills on the topic of biotechnology using 22 validated critical thinking questions on grade IX students in Bandung City Public Junior High School based on the scores obtained by students, namely in the very low category with a percentage of 2.65%, low category with a percentage of 9.74%, moderate or sufficient with a percentage of 38.05%, high category with a percentage of 31.86% and high category with a percentage of 17.7%. The profile of students' critical thinking skills based on inch indicators in a row from the highest to the lowest value is point of view 69.03%, elements of implication and concequences 65.49%, interpretation and inference 64.61%, information 62.83%, purpose 62.61%, concepts 60.47%, question at issue 56.64% and assumptions 42.04%. Based on the results of data analysis shows that class IX students can still be improved through learning activities.

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