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DESIGN OF PROJECT-BASED CRITICAL THINKING SKILLS ASSESSMENT INSTRUMENT FOR CLASS X HIGH SCHOOL STUDENTS ON CLIMATE CHANGE MATERIALS

Oria Lasmana[1*], Festiyed Festiyed[2], Abdul Razak[3], Muhyiatul Fadilah[4]
[1,2,3,4]Universitas Negeri Padang, Indonesia
Email: Orialasmana78@gmail.com[1], festiyedf@gmail.com[2], arazakunp@yahoo.com[3], Muhyifadilah@fmipa.unp.ac.id[4]

ABSTRACT

Critical thinking skills are one of the essential competencies that students in the 21st century must possess. Biology learning in high school emphasizes the development of critical thinking skills, which are essential abilities in understanding, analyzing, and evaluating complex information. This research aims to design a critical thinking skills assessment instrument based on Project-Based Learning for Class X High School Students on climate change material. This study uses a descriptive research method. The data collection technique in this study is by observation and literature study. The preparation of this assessment instrument is designed based on the Scientific Literacy Assessment (SLA). The data that has been collected is then analyzed in three stages, namely data reduction, data presentation, and drawing a conclusion. The results of the study show that a design of observation sheets and assessment instruments has been produced that can be used to measure students' critical thinking skills. This assessment instrument for students' critical thinking skills is designed based on SLAs and is ready to be validated so that a valid assessment instrument is produced. Teachers can use this assessment instrument to assess students' critical thinking skills in project-based learning. This instrument can also be used to provide constructive feedback to students and help them improve their critical thinking skills.

KEYWORDS *Design, Assessment, Critical Thinking Skills, Biology, Project Based Learning.*

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INTRODUCTION

Biology education in high school plays a crucial role in fostering critical thinking skills, which are essential for understanding, analyzing, and evaluating complex biological concepts. Critical thinking enables students to synthesize information, solve problems, and seek out relevant resources to support their conclusions (Fauziah & Kuntoro, 2022). Key indicators of critical thinking in this context include identifying the central issues, formulating questions and conclusions, analyzing arguments, and engaging in clarifying or challenging dialogues. Additionally, students learn to recognize decision-making terms and approach them thoughtfully, assess observation reports, and draw well-supported conclusions while maintaining an open mind despite potential disagreements or uncertainties (Smolkowski et al., 2020). By cultivating these skills, biology learning not only enhances students' understanding of the subject matter but also prepares them to tackle real-world challenges critically and effectively.

Assessment is an integral part of the learning process because educators can evaluate student learning outcomes through assessment. The assessment of learning outcomes carried out by educational institutions aims to assess the extent to which students have achieved the competencies set in all subjects (Fatimah et al., 2024). The assessment process is the main responsibility of educators in learning, which serves to determine the extent to which students can achieve the learning goals that have been set. The stages of information collection in the assessment process aim to make decisions on various aspects, such as educational policies, the quality of programs and curriculum, the quality of teaching, and students' understanding of the subject matter. Assessment activities carried out by educators are interpreted as an integral part of the learning system designed and implemented in the classroom (Paniagua & Istance, 2018; Schildkamp et al., 2020)

The application of critical thinking assessment is often carried out through essay tests; this is in accordance with the concept of critical thinking according to Ennis, which states that in tests, mental involvement, strategies, and representations are needed to solve problems, make decisions, and learn new concepts. However, McPeck found that essay tests have weaknesses and problems that cannot be ignored in the assessment process, namely the emergence of the effect of subjectivity in the examination of test results. Critical thinking skills are rarely measured using multiple-choice tests because there are many guessing factors in their implementation and the creation of test items requires special skills. However, critical thinking skills can be measured by multiple-choice tests, especially with items that emphasize high-level thinking (HOT) skills. In addition, the test instruments used to measure critical thinking skills must have a high level of difficulty (Mukti et al., 2021).

Critical thinking skills are one of the essential competencies that students in the 21st century must possess. Biology learning in high school emphasizes the development of critical thinking skills, which are essential abilities in understanding, analyzing, and evaluating complex information. Therefore, it is important to develop assessment instruments that can measure students' critical thinking skills in climate

change materials. Project-based learning (PBL) is an effective approach to improving these skills, as it encourages students to learn through practical experiences and real projects. Through PBL, students not only acquire theoretical knowledge but also apply that knowledge in real-world contexts, thereby strengthening their ability to think critically and solve problems relevant to daily life. The implementation of PBL in biology learning, especially on climate change material, can help students better to understand the impact and solutions to these global issues, as well as develop critical thinking skills that are urgently needed in this modern era.

Previous research by Amalia & Susilaningsih (2014) found that the instruments used in schools are generally at the cognitive taxonomic level of C1 to C2, with occasional use at the C3 level. The assessment instruments developed include analytical essay tests, student activity sheets, and problem-solving tests oriented to students' critical thinking skills. These instruments are declared valid and reliable and are able to measure the average student learning outcomes, the proportion of completeness, and student activities. Another research by Ainun, (Ainun, 2021) shows that the integrated assessment instrument product has an average score of 4.41, which is included in the valid category. This instrument is designed to measure critical thinking skills, creative thinking skills, and biological cognitive learning outcomes and is declared valid.

Similar research by Sugiarti, (2014) identified the characteristics of critical thinking skills assessment instruments, namely open-ended description questions with indicators that include argument analysis, deduction, induction, and presentation of information in the form of scenarios, texts, graphs, and tables. Data processing using the Anates V4 program showed the reliability of the instrument of 0.67 with high interpretation and the validity of the question of 0.47 with sufficient interpretation. Therefore, the critical thinking skills assessment instrument in the form of open-ended description questions meets the criteria for good test quality and can be used as a tool to measure critical thinking skills.

This research helps to improve the quality of education by providing effective assessment tools for teachers and increasing student engagement in learning. Theoretically, this study enriches the educational literature by offering new models and tools to measure and improve critical thinking skills in the context of scientific and global issues. This research aims to design a critical thinking skills assessment instrument based on Project-Based Learning for Class X High School Students on climate change material.

RESEARCH METHOD

This study employs a descriptive research method, which aims to accurately describe and interpret objects, individuals, groups, situations, or phenomena as they exist (Waruwu, 2023). The assessment instruments are designed using instructional research to create tools that effectively evaluate students' critical thinking skills. The design process begins by identifying the specific assessment aspects to be measured.

The assessment instrument is based on the Scientific Literacy Assessment (SLA), modified to meet the researcher's objectives. The SLA, developed by Fives et al. (2014), consists of two components: SLA-D (Demonstrated) and SLA-MB (Motivation and Beliefs).

Data will be collected through observations of student behavior and classroom interactions, specifically focusing on their critical thinking skills in relation to climate change materials. Additionally, a literature study will support the observational data by providing context and background information on effective assessment practices. The analysis of the collected data will occur in three stages: data reduction, data presentation, and conclusion drawing. This structured approach will ensure a comprehensive understanding of students' critical thinking abilities.

RESULT AND DISCUSSION

Result

The following is an observation grid of students' critical thinking skills used.

Table 1. Observation Grid of Students' Critical Thinking Skills

Variable	Indicators	Number of Question Items	Items Statement	No. Statement
Students' critical thinking skills	1. Focus the question	1	Formulate questions and criteria to consider answers and ask questions logically	1
	2. Ask and answer questions	1	Ask questions, give explanations and mention examples	2
	3. Consider whether or not a source is trustworthy	1	Consider authenticity, suitability of sources and use of appropriate procedures	3
	4. Observe and consider observation reports	1	Make observations, make reports and use the correct evidence	4
	5. Create and determine the outcome of the consideration	1	Making and determining the basis of consideration based on facts, based on	5

		consequences and based on the application of facts	
6. Define an action	1	Uncover the problem, choose a possible solution and observe its implementation	6
7. Interact with others	1	Arguing, using logical thinking and showing orations or writing	7

Furthermore, the results of the observation were carried out to measure science literacy skills; the results are shown in Table 2, which shows that the science literacy ability of Class X high school students in climate change material based on the cognitive domain SLA instrument (SLA-D) got an average of 57.80% in the medium category. The highest aspects of science literacy are the aspects of science and society, followed by thinking and working scientifically, the role of science, and mathematics and science.

Table 2. Results of the Cognitive Science Literacy Test

Science Literacy Aspects	Indicators	Question No.	Score Per Aspect
The Role of Science *(Role of Science)*	Create and determine the outcome of the consideration	5	56,50%
	Define an action	6	54,00%
Scientific *thinking and doing*	Consider whether or not a source is trustworthy	3	57,50%
	Observe and consider observation reports	4	55,50%
Science and society	Interact with others	7	65,50%
Math and science *(Mathematics and science)*	Focus questions	1	54,50%
	Ask and answer questions	2	53,50%
Average			57,80 %

Discussion

The study's results found that the average of the four aspects of science literacy of Class X high school students in climate change material is in the medium category. The highest percentage is in the aspect of science and society, which is 65.50%, followed by thinking and working scientifically at 56.50%, then the role of science at 55.25%, and mathematics and science at 57.80%.

In the science literacy component, the aspect of the role of science is in the medium category, with an average score of 55.25%. Thus, students have fully understood the role of science in daily life. Science in daily life plays an important role in helping the quality of life by providing innovations that improve health, facilitate communication, improve work efficiency, and support sustainable economic development (Fitriyadi et al., 2022). The role of science in climate lessons is to provide understanding and technology that enables people to anticipate climate change, reduce disaster risk, and adopt sustainable practices that improve the quality of life.

In the science literacy component, the aspect of thinking and working scientifically is in the medium category, with an average score of 56.50%, meaning that students are capable of thinking and working scientifically. This result is different from the results of the Fausan & Pujiastuti (2017a) study, which found that thinking and working scientifically are still lacking. So, it can be concluded that class X students have enough to think and work scientifically in climate lessons if they can collect data, analyze information, identify patterns, make hypotheses, and formulate evidence-based solutions to climate issues.

The science literacy component of science and society aspects received an average score of 65.50% in the high category, meaning that students are good at understanding the importance of science in its implementation in daily life if they can apply scientific concepts to solve real problems and make decisions that support health, the environment, and social welfare (Asmaturisa et al., 2023).

The last component of science literacy, namely the mathematics and science aspects, showed an average score of 54%, so it was in the low category. This is in line with the research of Rohana et al. (2020), which stated that students are still lacking in implementing mathematics in science. In the research, Fausan (2017b) also mentioned that mathematics and science have almost no connection. Thus, high school students in grade X still lack in implementing mathematics in science in climate lessons due to a lack of understanding of relevant mathematical concepts and how to apply them in scientific contexts, as well as the lack of learning practices that integrate the two disciplines effectively.

In the medium category, the average science literacy ability of class X students was obtained at 57.80%. So it can be concluded that the science literacy ability of class X students is quite good. The importance of science literacy skills because it allows individuals to understand, evaluate, and apply scientific information in daily decision-making, participate in community discussions related to scientific issues, and encourage innovation and technological advances that have a positive impact on the quality of life and the environment (Pertiwi et al., 2018).

Science literacy skills support learners to critically analyze, evaluate, and synthesize scientific information, while critical thinking skills aid in questioning assumptions, identifying biases, and crafting arguments supported by strong evidence. Science literacy skills allow students to understand scientific contexts and formulate rational reasoning based on the information provided. In contrast, critical thinking skills help in sharpening the analysis and assessment of the information, so the two work together to strengthen individual abilities in responding to various scientific issues and making informed decisions (Ugliotti et al., 2023).

Biology learning in high school requires critical thinking because it involves understanding complex concepts such as ecosystems, genetics, evolution, and the interaction of organisms with their environment (Puspita et al., 2019). Critical thinking allows students to evaluate data, connect concepts, identify patterns, and construct logical reasoning in answering complex questions in biology. In addition, by thinking critically, students can develop the analytical skills necessary to understand human impacts on the environment, evaluate scientific information found in the literature, and identify and design solutions to complex biological problems (Putriningtyas et al., 2022).

In addition, the project-based learning model also intrinsically encourages critical thinking. Students not only receive knowledge passively, but they are actively involved in the process of inquiry, analysis, and problem-solving that requires critical reasoning (Nugraha et al., 2023). By tackling projects relevant to climate change material, students are faced with the challenge of connecting theory with practice, devising problem-solving strategies, and evaluating their work. Students learn to think critically about how to overcome the complexity of the problem and gain a deeper understanding of the impacts of climate change and mitigation efforts that can be done (Daniel, 2017). Thus, project-based learning facilitates the application of science literacy and stimulates the development of students' critical thinking skills.

Thus, through project-based learning, students are given the opportunity to investigate climate change issues in depth, apply scientific knowledge in real contexts, and face complex challenges that require critical analysis. Using science literacy, students can collect data, evaluate information sources, and construct arguments supported by scientific evidence, while critical thinking skills allow them to question assumptions, identify biases, and formulate evidence-based solutions to the climate change problems at hand. So the combination of science literacy skills and critical thinking skills through project-based learning becomes an effective instrument in strengthening understanding and solving complex issues such as climate change at the high school level.

CONCLUSION

The conclusion of this research is that the development of a critical thinking skills assessment instrument based on Project-Based Learning (PBL) for Class X high school students on climate change material has been successfully accomplished. This

instrument is designed with consideration of the Scientific Literacy Assessment (SLA) components and is ready for validation to ensure its validity. Observational results indicate that the average science literacy skills of students are in the medium category, with the "science and society" aspect showing a good understanding of the application of science in everyday life. This research not only provides effective assessment tools for teachers to evaluate students' critical thinking skills but also helps students receive constructive feedback and improve their critical thinking abilities. Thus, PBL proves to be effective in enhancing students' critical thinking and science literacy skills related to complex issues such as climate change.

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