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Enhancing Students' Critical Thinking Skills Through Problem-Based Learning Values Clarification Technique (PBLVCT) on The Human Respiration System Concept

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ABSTRACT

The purpose of this research is to develop a Problem-Based Learning Values Clarification Technique (PBLVCT) model for teaching the human respiration system and to evaluate its effectiveness in enhancing students' critical thinking skills. The study employed a quasi-experimental method with a pretest-posttest control group design. Two groups, selected through convenience sampling, were used as research samples. Data were collected using pre-tests and post-tests in both groups, and analyzed using the Paired Sample T-test to identify differences in critical thinking skills between the groups after the intervention. Additionally, the N-Gain test was used to assess improvements in critical thinking skills. During the learning process, students were supported with electronic Learner Worksheets (e-LKPD) to facilitate adherence to the learning model's syntax. The results indicated a significant increase in students' critical thinking skills following the implementation of the PBLVCT model, with the experimental class showing a higher N-Gain value compared to the control class. Therefore, teaching Biology with an integrated character values through the PBLVCT model can enhance students' critical thinking skills, enabling them to address social issues in their environment and develop sustainable solutions that benefit both themselves and their communities. This research is expected to contribute to the development of teaching methods and curricula, particularly in enhancing and innovating the implementation of character education in schools.

Keywords: *Problem Based Learning Values Clarification Technique (PBLVCT) model, Critical thinking skills, Respiration system in humans.*

INTRODUCTION

The advancement of science has profoundly affected the mindset, character, and ethics of the younger generation, as traditional lifestyles evolve into more sophisticated and modern ways of life (Nudin, 2020). To navigate the changes occurring in society and the world, students, as the younger generation, must be able to adapt to the continuously evolving time (Efendi et al., 2022) Education plays a crucial role in this adaptation, serving as the foundation for instilling strong character values. This approach aims to prepare future leaders who can wisely address contemporary challenges and contribute positively to society (Lange et al., 2023).

In essence, the purpose of education extends beyond intellectual development; it also aims to cultivate an understanding of character values. Education is not just about acquiring knowledge but also about learning how to integrate and embody these values in daily life, shaping individuals who are both knowledgeable and ethically grounded (Suhifatullah et al., 2021). By

gaining these insights, the younger generation will be better equipped to navigate and withstand the pressures and influences of modern times. This understanding helps them remain grounded in their values, making them less susceptible to being swayed by fleeting trends and external pressures (Kobandaha et al., 2021). Education that emphasizes character value cultivation is outlined in Article 3 of the Republic of Indonesia's Law No. 20 of 2003. This law indicates that the goals of national education extend beyond mere academic achievement to include the development of character values. The aim is to ensure that students achieve a well-rounded balance of learning competencies, integrating both intellectual and moral growth (Ula & Suwarno, 2023).

However, in practice, character education is often not effectively implemented in schools. This is partly due to the assumption that academic content and character education are separate and cannot be integrated (Sayuti & Rahiem, 2020). This strict division implies that academic knowledge and character values are seen as separate and cannot be integrated within the same educational framework (Amri et al., 2017). As a result, the emphasis often shifts predominantly toward academic achievements, leading to a neglect of the crucial task of nurturing strong character values among students (Mustaqimah & Dahlan, 2023).

The urgent need to implement character education arises from the increasingly alarming deterioration in the character of the younger generation. Recent observations conducted in December 2023 by 26 high school teachers in the Bandung area of West Java reveal the extent of this problem. The findings show that 84% of teachers have encountered issues related to students' lack of character values, ranging from mild to severe cases. These include: (1) frequent complaints about students' lack of manners in communication, both with peers and with teachers or elders, (2) a noticeable prevalence of individualism, low social awareness, and lack of environmental concern among students, (3) instances of dishonesty, and (4) severe cases such as bullying, teenage pregnancies, involvement in motorcycle gangs, drug use, smoking, and alcohol consumption. These observations underscore the need for education agents to address the root causes and potential consequences of declining student character and to find effective solutions. Consequently, character education in schools is crucial for developing the younger generation into thoughtful and responsible individuals capable of adapting to changing times, as one of the primary goals of education is to cultivate both knowledge and character (Apiyani, 2022).

To effectively foster character values through school management, several strategies can be employed to incorporate these values into daily life within the educational environment. Schools can integrate character values into their codes of conduct and regulations, emphasizing principles such as integrity, respect, and responsibility. One effective approach is to weave character education into general classroom instruction. This integration offers an innovative solution for schools that currently separate academic intelligence from character development. Each subject area has its own set of norms that can be developed and related to real-life contexts. The core of integrating character education is to guide students consciously and intentionally, helping them to adopt and exemplify positive values. This approach ensures that character development becomes a fundamental part of the educational experience (Ambarwati, 2023).

This research illustrates that the application of an integrated learning model of character values, in addition to being required to strengthen character value education, is also expected to be able to develop students' thinking skills. The thinking skills in question are critical thinking, which is needed by every learner in the 21st century and is the key to success in every educational goal (Hidayati et al., 2021). Critical thinking skills are skills that form the fundamental basis that supports the growth of other thinking skills. This is relevant to the results of initial observations in this study which revealed that 61.5% of teachers agreed that critical thinking skills are the most crucial skills among other thinking skills.

The fact that is found in most schools, the level of critical thinking of students is classified as a thinking skill that must be improved and becomes the main focus in developing students' learning competencies (Suriati et al., 2021). Based on the results of a preliminary study related to the condition of critical thinking skills, 80.8% of 26 high school teachers in Bandung admitted that students still have difficulty practicing their critical thinking skills. All of these teachers agreed that the urgency to improve these thinking skills must be carried out optimally, considering that in general, as many as 76.9% of teachers stated that their students' critical thinking skills were in the medium criteria, and the remaining 19.9% were in the low criteria. In line with that, there is related research conducted by Anesa (2021). This discusses the level of thinking skills of students who are categorized into five categories, from very critical to uncritical, and the results show that they are still in the less critical category. Other research that reveals the low critical thinking skills of students are the main task of teachers in realizing an innovative learning atmosphere and developing their thinking competencies (Hidayati et al., 2021).

The low critical thinking skills of students are also discussed in research by Fitriani et al., (2022) which reveals that the critical thinking skills of Indonesian students have not been fully empowered. The majority of students tend to be passive recipients of information from teachers. This reflects that students receive more information rather than being actively involved in critical thinking which should be an important element in their educational experience. Even in schools teachers still rarely create learning conditions that train aspects of critical thinking skills. The aspects of critical thinking skills according to Facione (2020) include 1) interpretation, 2) analysis, 3) evaluation, 4) inference, 5) explanation, and 6) self-regulation. Therefore, all teachers need learning innovations that can improve critical thinking skills while strengthening students' character value education.

Integrating character values in learning is important to ensure that the approach used meets three main principles: relevance, consistency, and adequacy. First, learning materials should be relevant to the competency standards and basic competencies set so that students can relate character values to their academic learning concretely. Second, consistency is needed to ensure that every aspect of the basic competencies that students must master is reflected in the learning materials so that character values can be integrated evenly and comprehensively. Finally, the principle of adequacy emphasizes that the material taught should be sufficient and in-depth enough to help students understand and apply the character values in their daily lives so that learning does not only focus on academic aspects but also holistic personal development. By paying attention to these three principles, teaching can be more effective and innovative in creating a learning environment that supports students' overall character growth (Komalasari in Eka Santika, 2020).

Many learning pedagogy techniques can be applied by teachers in integrating character values into classroom learning. Ambarwati (2023) presents several studies of innovations in the implementation of character values integrated learning, including the following: (1) a consideration model that guides students in considering every problem related to learning can form a focus on empathy and caring, (2) cognitive-based affective learning model that aims to build students' morality, (3) value clarification technique that aims to guide students in forming character values that they consider good, which will ultimately affect how they act in social life. Among the three learning models, the Values Clarification Technique (VCT) learning model has been re-innovated by educational researchers because this model can train students to be directed to find, choose, analyze, decide, and take an attitude toward life values that want to be interpreted and applied in everyday life (Fetra et al., 2020).

The integration of character value education into the content of academic materials requires a structured learning procedure that can stimulate students to be motivated to "learn how to learn." The learning model is the Values Clarification Technique (VCT) where students are directed to find, choose, analyze, decide, and take their attitude toward life values that they

want to interpret and apply in their daily lives (Fetra et al., 2020). The effectiveness of this model is highly dependent on the skill of educators in asking high-level questions that can explore and reveal the values of students. In addition, the application of VCT requires educators' creativity in using relevant and actual learning media, to be closer to the reality of students' lives (Febriany et al., 2021). This is the background of this research to combine the VCT model with a problem-based learning (PBL) model. Learning that involves students in problem-solving related to the context of character education degradation problems is expected to encourage the active involvement of students in building their knowledge, developing higher-level skills, and inquiry abilities, as well as achieving independence in the learning process, and increasing their level of confidence. This learning model can also train students' skills in integrating character value education in learning materials (Harahap & Darmana, 2020).

The implementation of the PBL and VCT learning model into a Problem Based Learning Values Clarification Technique (PBLVCT) learning model has been carried out by previous researchers by Pernantah (2020) in History subjects, while this research implements the learning model in Biology subjects precisely on human respiration material. In addition, this research also contains modifications of some of the syntax of the PBLVCT learning model. This learning model becomes a learning package that can complete the essentials of biology learning content as well as the urgency of character education that students must have in the learning process. The purpose related to the application of the combination of these two learning models is to answer educational problems that often occur in schools, namely students' thinking skills such as critical thinking skills possessed by unbalanced students. Learning that internalizes character values will be more meaningful and by the overall national education goals (Husna et al., 2020).

Therefore, this study discusses the implementation of the Problem-Based Learning and Values Clarification Technique (PBLVCT) learning model to measure the level of critical thinking skills of grade XI high school students. This learning model is applied to Biology material on KD 3.8 related to the Human Respiration System, considering that this material is one of the topics that is difficult for students to understand because it contains complex bioprocess content and is also abstract (Silaban, 2022).

METHODOLOGY

This study uses a quasi-experimental method with a pretest-posttest control group design that aims to see whether the Problem-Based Learning Values Clarification Technique learning model can improve the critical thinking skills of students in one of the Senior High Schools in Bandung City on human respiration material.

There are two groups or classes used in this study including experimental classes that are given learning treatment, and comparison classes that are given different treatments from the experimental class. The research design adapted from the research design illustrated by Creswell (2012) as in Table 1.

Table 1. Research Design.

Group	Pretest	Treatment	Posttest
Experiment	O1	X1	O2
Control	O1	X2	O2

Description:

X1: Treatment of the experimental class using the Problem Based Learning Values Clarification Technique model.

X2: Comparison class that conducts learning activities with the Problem Based Learning model.

O1: Pre-test to measure critical thinking skills possessed by students, this test is given before the application of the learning model.
O2: Post-test to measure the critical thinking skills of students after the implementation of the learning model.

In Table 1. It can be concluded that the experimental class is the class that is given treatment by organizing the Problem-Based Learning Values Clarification Technique (PBLVCT) model. In learning in the experimental class, learning activities followed by students are guided by electronic Learner Worksheets (e-LKPD) to stimulate them in practicing their critical thinking skills. This learning is divided into several activities according to the syntax to be more focused. While the comparison class is a class that is given treatment in the form of Problem Based Learning (PBL). Similar to the experimental class, learning activities in the comparison class were also guided by electronic Learner Worksheets (e-LKPD) but the difference was that there was no syntax for the Values Clarification Technique learning model carried out.

The population in the study was the critical thinking skills of high school students from the Natural Sciences program in one of the Boarding School High Schools in the city of Bandung. Sample in this study consists of 42 students from Class XI in the Science program, focusing on their critical thinking abilities. The convenience sampling technique is a sampling method that is carried out by selecting subjects or research units based on the availability and convenience of the researcher. In the context of this study, the convenience sampling technique was chosen because the population that became the object of research was limited to two classes, namely eleventh-grade natural science I and eleventh-grade natural science II. These two classes are the only relevant data sources and cover the entire population to be investigated. The decision to use convenience sampling was based on the limited number of classes and data availability in one of the high schools in Bandung City. Although convenience sampling has limitations, it is expected that the results of the study will still provide valuable insights related to the level of critical thinking skills of students in the two classes.

The research data collected includes critical thinking skills data and learning implementation data based on documentation of teacher and student activities during learning. The instruments used in this study consisted of 12 items of critical thinking questions that refer to the rubric adapted from Facione (2020) and Fitriani et al., (2019), In addition, this study also included a documentation sheet of students' activities during the learning process. In addition, this research is also equipped with learning e-LKPD which is a learning media that supports the smooth running of the research. After the data collection process, the N-Gain Test was conducted to determine the significance of the improvement of students' critical thinking skills.

RESULT AND DISCUSSION

Implementation of Problem Based Learning Value Clarification Techniques (PBLVCT) Learning Model

The application of the learning model implemented in this study is the syntax of the Problem Based Learning Value Clarification Techniques (PBLVCT) model. This model can be combined into an innovative learning model because it not only trains thinking skills but also at the same time shapes the character possessed by students in a better direction. This learning model can be considered as a response to the demands of the 21st century, one of which is to train students' critical skills. In addition, students are not only active participants in learning but also build solid character and ethical values. This model creates a positive learning environment, strengthens social bonds, and increases learning motivation (Pernantah, 2020).

In this study, the application of the PBLVCT learning model syntax is associated with the achievement of critical thinking indicators adapted from critical thinking indicators by Facione

(2020) among them are interpretation, analysis, evaluation, inference, explanation, and self-regulation. While the syntax of the PBLVCT learning model applied in this study is as follows: identification of problems, formulating problems and choosing values, planning investigations, carrying out investigations, analyzing the results of problem-solving and appreciating values, drawing conclusions, and implementing and actualizing character values. A documentation sheet during learning activities is expected to provide a comprehensive overview of the effective implementation of the PBLVCT learning model, as presented in Table 2 below.

Table 2. Documentation of Example of Core Activity Syntax of Learning Model in Experimental Class

Learning Stages	Activity Description	Critical Thinking Skills that are Trained
a) Stage 1 **Identifying the Problem**  **(Source:** Personal documentation, 2024**)**	1. Students identify problems from the video contained in the E-LKPD containing problems related to the human respiration system so that efforts must be sought to solve them, at this meeting the problems discussed are related to "the dangers of smoking".	**a. Interpreting** Students interpret problems related to phenomena found in everyday life by describing the relationship between these problems and material concepts related to the human respiration system. **b. Analyzing** Students can identify and connect between interpretations designed to express beliefs, judgments, experiences, reasons, information, or opinions according to the concept of the material being studied.
b) Stage 2 **Formulating Problems and Choosing Values**  (**Source:** Personal documentation, 2024**)**	2. Students in groups formulate the focus of the problems that have been identified. 3. Students select and determine examples (amtsal) or character values that can be integrated with the material related to respiratory diseases, how to prevent them, and the impact of smoking.	**a. Analyzing** Students can identify and connect between interpretations designed to express beliefs, judgments, experiences, reasons, information, or opinions according to the concept of the material studied. **b. Evaluating** Students can assess the credibility of statements related to the right concepts so that they can formulate the problems that have been identified.
c) Stage 3 **Planning the Investigation**	4. Students plan an investigation to answer the problem that has been given previously 5. Students conduct literacy on various learning resources or information on the internet to be	**Explaining** Students can explain the investigation plan that will be carried out after literacy of various learning sources or information on the internet to be able to plan investigations to help find hypotheses in the form of solutions to problems that have been formulated.

Learning Stages	Activity Description	Critical Thinking Skills that are Trained
 **(Source:** Personal documentation, 2024**)**	able to plan investigations to help find hypotheses in the form of solutions to problems that have been formulated.	
c) Stage 4 **Carry out the Investigation**  **(Source:** Personal documentation, 2024**)**	6. Students in groups collect evidence for the hypothesis through the investigation.	**Self-regulation** Students can consciously monitor the way of thinking, the elements used in the thinking, and the results obtained, assessing how to make their judgments, with the aim of questioning, confirming, validating, or correcting the results of thinking with the correct concepts/laws/principles. **Inference** Students can collect and examine the data needed to formulate appropriate conclusions or form conjectures and hypotheses correctly based on predictions, data, and graphics or images presented based on correct concepts.
e) Stage 5 **Analyzing Problem Solving Results and Appreciating Value**  **(Source:** Personal documentation, 2024**)**	7. Students analyze the suitability of the evidence obtained with the problem 8. After obtaining the results of the investigation, students in their groups develop a report on the results of the discussion 9. In turn, each group presents the results of its discussion, other students are allowed to refute, respond, or provide input on the results of the presentation and the teacher responds and provides feedback. 10. In the presentation, students also	**Analyzing** Students can identify and connect between interpretations designed to express beliefs, judgments, experiences, reasons, information, or opinions by the concepts of the material learned. **Evaluating** Students can assess the credibility of statements related to the right concept and evaluate these predictions based on variables that match the correct and appropriate concept. **Inferring** Students can collect and examine the necessary data to formulate appropriate conclusions or form conjectures and hypotheses based correctly on predictions, data, and graphics or images presented based on correct concepts.

Learning Stages	Activity Description	Critical Thinking Skills that are Trained
	analyze the character values that they determine and can be integrated into the material studied and can be used as ibrah to be exemplified in everyday life	
f) Stage 6 **Drawing Conclusions**  **(Source:** Personal documentation, 2024**)**	11. Students make conclusions based on evidence obtained from literacy and investigations that have been conducted.	**Explaining** Students can present the results of reasoning clearly and coherently based on correct concepts.
g) Stage 7 **Implementation and Actualization of Character Values**  **(Source:** Personal documentation, 2024**)**	12. Students use the problem-solving skills they have learned and select some character values that can be applied and exemplified in their daily lives.	**Self-regulation** Students can consciously monitor the way of thinking, the elements used in the thinking, and the results obtained, assessing how to make their judgments, with the aim of questioning, confirming, validating, or correcting the results of thinking with the correct concepts/laws/principles.

Adapted from the syntax of the PBL learning model by Widodo (2021) and the PBL &VCT learning model by Pernantah (2020)

Based on Tables 2, it can be concluded that the PBLVCT learning model was well implemented by students and also teachers who guided them during the learning process. This is indicated by the details of learner and teacher activities in each syntax in the core learning activities which can be described as follows:

First, is the problem identification stage. At this stage, the teacher shares the e-LKPD link with students through the Canva application. After that, students in groups are directed to watch videos related to problems related to learning topics that have been determined from the basic competencies in the material of the respiration system in humans. In this first stage, students are trained to interpret and also analyze intensely the problems contained in the video so that they can identify the problems that occur appropriately.

Second, formulate problems and choose values. Students in groups formulate the focus of the problem that has been identified previously into questions. The question will later produce a hypothesis as a temporary answer to the cause of the problem and how the right solution is to overcome the problem. At this stage, students are also directed to select and determine examples (*amtsal*) or character values that can be integrated with the learning material discussed at the

meeting. For example, related to respiratory diseases, how to prevent them, and the impact of smoking. The aspects of critical thinking skills that are trained are analyzing and evaluating skills.

Third, planning an investigation with critical thinking skills trained is the skill of explaining. Students plan investigations to answer the problems that have been given previously. Students conduct literacy of various sources learning or information on the internet to be able to plan investigations to help find hypotheses in the form of solutions to problems that have been formulated which then the hypothesis will direct students in planning an investigation to prove the hypothesis.

Fourth, investigating with the skills trained is self-regulation where students consciously monitor the way of thinking, the elements used for thinking, and the results obtained, assessing how to make their judgments, with the aim of questioning, confirming, validating, or correcting the results of thinking with the correct concepts/laws/principles, then at this stage students are also trained to make inferences, considering that in groups they collect evidence of the hypothesis through investigation. While the teacher will act as a facilitator and guide students in carrying out investigations.

The next stage combines three stages (stages Five, Six, and Seven) through presentation techniques. The explanation of these stages includes: Fifth, analyze the results of problem-solving and appreciate the value by training the skills of analyzing and evaluating. After collecting data from the results of the investigation, students will be directed to process and analyze the findings of the investigation that have been obtained, then, in turn, each group will present the results of their discussion, and other students will be allowed to refute, respond or provide input on the results of the presentation and the teacher responds and provides feedback In the presentation, students also analyze the character values they determine and can be integrated in the material studied and can be used as *ibrah* to be exemplified in everyday life. Sixth, concluding that exercise explanation skills. Students make conclusions based on evidence obtained from literacy and investigations that have been carried out. Seventh, implementation and actualization of values that train students' self-regulation. Students use the problem-solving skills they have learned and choose several character values that can be applied and exemplified in everyday life.

Analysis of the Improvement of Critical Thinking Skills of Students

The improvement of students' critical thinking skills is obtained from the results of the critical thinking test before the implementation of Problem Based Learning Values Clarification Techniques (PBLVCT) learning and after the implementation of learning. Data related to the critical thinking skills possessed by students are obtained from the results of the pre-test and post-test. The data can be summarized in Table 3.

Table 3. Recapitulation of Data on Critical Thinking Skills of Students

Data	Control Class		Experiment Class	
	Pre-test	**Post-test**	**Pre-test**	**Post-test**
Number of Students	21		21	
Minimum score	37,50	56,25	29,17	52,08
Maximum score	60,42	91,67	66,67	97,91
Average	48,48	76,28	49,62	77,43
Standard Deviation	7,34	8,87	10,13	12,77
Normality Test	0,090 (Normally Distributed)	0,093 (Normally Distributed)	0,366 (Normally Distributed)	0,051 (Normally Distributed)
Homogeneity Test	0,728 (Homogeneous)		0,380 (Homogeneous)	
Paired Sample T-test	0,000 (Significantly different)		0,000 (Significantly different)	

N-Gain	0,54 (Medium)	0,60 (Medium)

Based on Table 3. The Paired Sample T-test results for both control and experimental classes show a significance value of 0.00. The results of this hypothesis test explain that the P-value is smaller than the α value of 0.05 (reject H_0 and accept H_1), this indicates that there is a significant effect of the application of the learning model in each class. The first conclusion can be understood that the PBL learning model in the control class and the PBLVCT learning model in the experimental class have a significant effect on students' critical thinking skills. While for the acquisition of the average post-test value of critical thinking in the control class is lower at 76.28 compared to the average value of critical thinking in the experimental class of 77.43. The data in Table 3. proves that the critical thinking skills of students in the experimental class are higher than in the control class. This is due to the provision of variations through the addition of the VCT learning model syntax to the PBL model in the experimental class so that students are trained to solve problems related to respiration material in humans while integrating character values. In other words, students have a broader mindset and logic because they can find a solution to the problem at hand not only by relying on intelligence but accompanied by strong character values. According to Johnson et al., (2023) improving critical thinking skills and evaluating them presents various challenges and varied factors. Given that thinking skills must be trained gradually and cannot be instantaneous, and must be consistent and also innovative. Therefore, this research is expected to be used as one of the insights that adds insight for teachers and further researchers to innovate learning that focuses on improving students' critical thinking skills.

Based on data from Table 3. Shows that the N-Gain value of the control class is 0.54 which shows a moderate interpretation and the N-Gain value of the experimental class is 0.60 which shows a moderate interpretation. From these data, it explains that the N-Gain value in the experimental class is higher than the N-Gain value of the control class. This proves that there is a more significant increase in critical thinking skills in the experimental class than in the control class. The detailed comparison data related to the improvement of essential skills of critical thinking between the control class and the experimental class was obtained by conducting the N-Gain test per dimension which is depicted in the following graph.

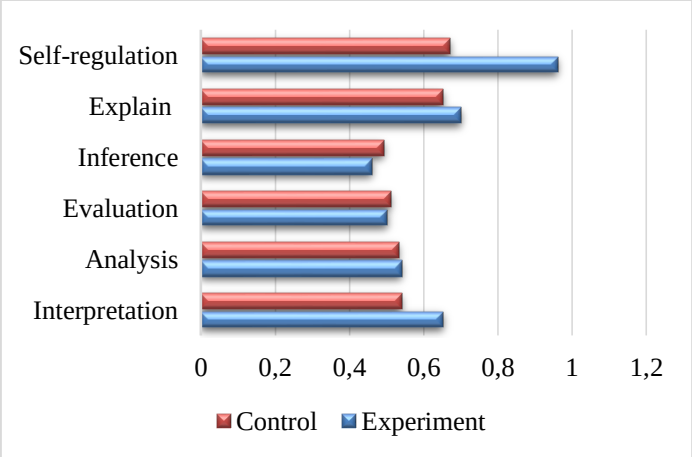

Figure. 1 Comparison Data of N-Gain Values of Critical Thinking Skills of Students in Experiment Classes and Control Classes

The graph above shows the comparison of N-Gain values in the experimental and control classes. The data presented in the graph above indicate the improvement in six critical thinking indicators for students learning about the human respiratory system using the Problem-Based Learning Values Clarification Technique (PBLVCT) in the experimental class and the Problem-Based Learning (PBL) model in the control class. Based on this graph, it can be

concluded that of the six critical thinking indicators, there are four critical thinking indicators in the experimental class higher than in the control class. The indicators include interpretation, analysis, explanation, and self-regulation, this is evidence that learning in PBLVCT in experimental classes can improve students' critical thinking skills with a more significant increase than in control classes. The detailed results are as follows:

First, in terms of interpretation skills, the experimental class using PBLVCT showed a significant improvement with an n-Gain of 0.65, compared to 0.54 in the control class using the PBL model. This increase is attributed to the addition of the values clarification syntax, which deepens students' understanding of the information, facilitating a more comprehensive and contextual interpretation. In contrast, the PBL model, which does not incorporate this intrinsic values technique, focuses solely on problem-solving without delving into the meaning and context of the information. Thus, the PBLVCT technique, by providing a value clarification context, enhances students' interpretation skills.

Second, regarding analysis skills, both models demonstrated similar effectiveness, with n-Gain values of 0.54 for PBLVCT and 0.53 for PBL. The minimal difference in improvement indicates that both methods are equally effective in enhancing analysis skills, suggesting that while PBLVCT offers an integrated approach with character values, its impact on analysis skills does not differ significantly from the PBL model.

Third, evaluation skills showed nearly identical improvement between the two models, with n-Gain values of 0.50 for PBLVCT and 0.51 for PBL. Despite this nearly equivalent increase, factors affecting the higher evaluation scores in the control class may include the context and implementation of the values clarification technique (VCT). The VCT in PBLVCT aims to help students identify and integrate values into learning, but the practical impact on evaluation skills may be influenced by students' experience and readiness to adapt to this new approach.

Fourth, inference skills were slightly better in the control class (n-Gain 0.49) compared to the experimental class (0.46). This difference indicates that students in the control class, using the PBL model, were somewhat better at making inferences. The higher score in the control class may result from a more focused problem-solving approach, which accelerates inference skills development. Conversely, PBLVCT introduces additional complexity by incorporating values clarification, which requires more time and experience to effectively apply in making inferences.

Fifth, in terms of explaining skills, the PBLVCT model demonstrated a greater improvement with an n-Gain of 0.70, compared to 0.65 for the PBL model. Explaining involves conveying information clearly and structurally. PBLVCT helps students organize their explanations by considering various values and perspectives, enriching their arguments. The values clarification technique supports students in creating explanations that are not only logical but also relevant to underlying values, making their explanations more persuasive and meaningful.

Finally, PBLVCT showed a significant increase in self-regulation with an n-Gain of 0.96, far surpassing the 0.67 achieved by the PBL model. Self-regulation in this study refers to students' ability to manage and control their learning processes, including behavior, emotions, and cognitive processes. The values clarification technique in PBLVCT enhances self-regulation by encouraging students to reflect on and manage their personal values in the context of learning. This consideration of personal values boosts students' motivation and direction in managing their learning process, whereas the PBL model, lacking this values component, does not offer the same level of support for reflection and self-regulation.

Overall, PBLVCT is effective in enhancing interpretation, explanation, and self-regulation skills, although its impact on analysis, evaluation, and inference skills does not show significant

differences compared to the PBL model. Related research, such as Irwansyah (2019) demonstrates that problem-based learning integrated with character values results in improved critical thinking skills, with indicators of critical thinking moving from adequate to good. Similarly, research by Sakti et al., (2023) shows that integrated character-value learning substantially improves critical thinking skills by broadening students' understanding of values and increasing their self-awareness. This type of learning not only promotes active student engagement but also strengthens their ability to critically analyze and evaluate information. Problem-based learning that is packaged in a complex and innovative way (applied with other supporting learning methods or models) can improve students' thinking skills, especially critical thinking skills (Arifah et al., 2021). This is also reinforced by Pernantah (2020) who explains that problem-based learning models combined with character-based models are a solution for teachers to improve students' learning competencies. Integrated character values learning in biology education, using the PBLVCT model, produces students who possess critical thinking skills necessary for analyzing social issues and seeking sustainable solutions. Thus, the findings from this study are expected to contribute as a reference for future researchers to innovate character-integrated learning models to enhance both the learning competencies and character values of students towards improvement.

CONCLUSION

The research results related to the application of the PBLVCT learning model on the material of the human respiration system showed a significant improve in training students' critical thinking skills. In addition, this study summarizes the overall implementation of the PBLVCT learning model. The syntax of this learning model consists of several stages including (1) Problem Identification that trains interpretation and analyzing skills; (2) Formulating Problems and choosing values with critical thinking skills that are trained, namely analyzing and evaluating skills; (3) Planning Investigations with critical thinking skills that are trained are explaining skills; (4) Carrying out Investigations with inference and self-regulation skills are trained at this stage; (5) Analyzing Problem Solving Results and Appreciating Values by training analyzing and evaluating skills; Drawing Conclusions that train explaining skills; and (6) Implementation and Value Actualization that train self-regulated by students. Implementing the PBLVCT model for students in schools requires hard work. It also requires innovation to implement value education, specifically through integration with learning. Thus, the findings from this study are expected to contribute as a reference for future researchers to innovate character-integrated learning models to enhance both the learning competencies and character values of students towards improvement. On the other hand, teachers must consider many things as agents of character building. The crucial things that need to be understood before internalizing character values is that teachers need to improve their understanding of the concept of character education.

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