



IMPROVING JUNIOR HIGH SCHOOL STUDENTS' CRITICAL THINKING THROUGH SCAFFOLDING METHODE ON HEAT CONCEPT

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Abstract

Critical thinking helps students develop the ability to analyze information, search for evidence, and make decisions based on open and logical thinking. This study measures junior high school students' critical thinking on heat concepts by implementing the Scaffolding method. This research used a pre-experimental method with a one-group pre-test and post-test design with a quantitative approach. The subjects of this research were 57 seventh-grade students in junior high school. The results show that the paired sample t-test is $0.000 < 0.05$, which shows that the Scaffolding method effectively improves students' critical thinking skills on heat concepts and is confirmed by the n-gain test of 0.73 in the high category. It can be concluded that the Scaffolding method effectively increases junior school students' critical thinking skills.

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INTRODUCTION

Critical thinking helps students develop the ability to analyze information, search for evidence, and make decisions based on open and logical thinking. Thinking skills are life skills that must be developed starting from learning activities. Logical thinking and rational thinking include basic thinking skills, while critical thinking, creative, problem-solving, and decision-making abilities include complex and higher-order thinking skills [1].

Critical thinking is a disciplined intellectual process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and evaluating information gathered based on observation, experience, reflection, or communication as a guide for beliefs and actions [2]. Critical thinking is an organized process that allows someone to evaluate the evidence, assumptions, logic, and language underlying other people's statements. In line with the thoughts stated by Chafee, J. critical thinking skills are active, directed, and organized thinking to understand a phenomenon by analyzing our thoughts and the thoughts of others to clarify and improve our understanding [3].

Critical thinking is a process of active intellectual discipline with conceptualizing, applying, analyzing, synthesizing, and evaluating information by observing, reflecting, reasoning, or communicating to guide beliefs and decision making on the problem. Faced.[4]. A thinking process occurs in someone who aims to make rational decisions about something that can be believed to be accurate. Critical thinking is purposefully analytical and involves original thinking by processing knowledge to identify cross-disciplinary relationships and find creative solutions to solve problems.

Critical thinking skills can be achieved by implementing the learning curriculum. Critical thinking skills are described as a thinking process that requires high cognitive processes [5] through problem analysis, argumentation, evaluation, decision-making, and problem-solving [6]. In addition, critical thinking can be described as a systematic process that allows someone to evaluate the evidence, assumptions, and logic underlying their opinions and the opinions of others to develop a deep understanding that can influence life in the future [7,8]. Therefore, school learning activities should be able to develop students' critical thinking skills.

Several research results state that practicing critical thinking skills will influence learning concentration, intellectual intelligence, and learning motivation [9]. The development of a person's mindset is also influenced by knowledge when learning and receiving information. Furthermore, interaction activities during the learning process also affect critical thinking. An active and conducive learning process can motivate students in the learning process, increase learning concentration and solve a problem presented [10]. Critical thinking influences students' personalities, such as controlling emotions, thought patterns, culture, and solving problems [11].

In modern times, learning that trains critical thinking can achieve curriculum achievement competency standards and design future life with more competitive challenges and competition [12,13]. Learning methods and the role of the teacher are the main factors in practicing critical thinking. Therefore, so that students can have thinking skills, teachers should explore to utilize the teacher's teaching methods [14]. To train students' critical thinking skills, teachers should apply learning methods that actively involve students in learning activities so that students can understand and apply concepts fully and make rational decisions.

The learning method students need can train their ability to learn and improve their critical thinking skills [15]. There are many learning models in the 21st century that can improve students' scientific thinking [16]. Research results show that applying the Scaffolding method can develop students' learning abilities and improve high-level thinking abilities in solving problems [16]. An educator must have creativity in choosing a learning method to maintain the learning process. One type of learning method that can help improve learning outcomes is the scaffolding method. Teachers' lack of effective use of techniques or methods in the learning process is the cause of low student learning outcomes [17]. The Scaffolding method is based on Vygotsky's theory that learning occurs when students learn to handle tasks that have not yet been realized, but the task is still within the reach of their abilities or is in the Zone of Proximal Development (ZPD) [18].

Several previous studies have proven the effectiveness of the scaffolding method; science learning using the PBL model with scaffolding is felt to overcome students' low conceptual understanding and self-efficacy in science learning. And also the application of scaffolding can also encourage learning activities and motivation to increase students' understanding of concepts [19,20]. Scaffolding can be provided through guidance, direction, reinforcement, and motivation. There is a significant difference between students' science learning outcomes using the problem-based learning model and the scaffolding technique for students' rational thinking abilities on the second criterion. An important relationship exists between rational thinking abilities and learning outcomes [21,22].

Based on several studies above, regarding the application of the Scaffolding method, which can improve students' critical thinking skills, the researchers innovated by developing the Scaffolding method in the learning process and the importance of this research, which is likely to provide more significant results on students' critical thinking skills. Thus, this research aims to improve junior high school students' critical thinking skills in heat material by applying the scaffolding learning method.

RESEARCH METHODS

This research uses a quantitative approach using a pre-experimental design method type one group pretest-posttest. One group pretest-posttest design is a research activity that provides an initial test (pre-test) before being given treatment, then after being given treatment, offers a final test (post-test) [23]. The research phase begins (pre-test) by measuring critical thinking skills, followed by applying the scaffolding method, and a post-test is given to measure essential thinking skills after treatment. This research was conducted in June 2023. The subjects in this research were seventh-

grade students. The sampling technique used is purposive sampling by collecting data using pre-determined instruments, and analyzing the data to test a theory, show a certain variable, and make a hypothesis. To measure critical thinking skills, use a test instrument consisting of categories and indicators of critical thinking skills shown in Table 1. [24]

Table 1. Indicators of Critical Thinking Skills

Critical thinking skills category	Indicator of critical thinking skills
Reasoning	<ul style="list-style-type: none"> Analyzing different perceptions Interpreting to understand the text
Hypothesis testing	<ul style="list-style-type: none"> Understanding information from multiple sources to draw valid conclusions Examining the experiment data to draw conclusions
Argument analysis	<ul style="list-style-type: none"> Generalizations from data experiment Identifying critical information that is missing from an argumentation
Problem-solving and decision-making	Examining the consequence of procedures in solving problems

Following the implementation of the Scaffolding learning approach, the average normalized gain score (g) is used to calculate the increase in students' critical thinking skills using equation "(1)" as follows.[25].

$$g = \frac{Sf - Si}{Maximum Si} \tag{1}$$

Sf Average pre-test score, Si average post-test score. The following criteria were applied to characterize the normalized gain that increased in students' critical thinking skills, and this research uses a critical thinking test instrument with 15 essay questions that refer to the indicators in Table 2:

Table 2. Average Normalized Gain Criteria

Average Normalized Gain Value	Criteria
$\langle g \rangle > 0,70$	High
$0,30 < \langle g \rangle < 0,70$	Medium
$\langle g \rangle < 0,30$	Low

RESULT AND DISCUSSION

The N-Gain result to amount students' critical thinking skills is shown in Table 3.

Table 3. Average Results of Students' Critical Thinking Skills

Classes	N	Pre-test	Post-test	N-Gain	Category
A	36	49,86	87,42	0,75	High
B	36	50,31	87,22	0,74	High

Note: N = number of research participants

Table 3. revealed that the average pre-test scores for classes A and B are 49.86 and 50.31, respectively. The average pre-test results demonstrate the disparity in average scores between class A and class B students' critical thinking skills. Following the scaffolding method's implementation, improving the critical thinking skills of the junior high school children in both classes. An increase in critical thinking skills of 37.56 was observed in Class A, with an average post-test score of 87.42, falling into the high group. Concurrently, class B demonstrated a 36.91 rise in critical thinking skills, with an average post-test score of 87.22, falling into the high range. The results of hypothesis testing that have been described explain that during learning, students will be trained to hone their critical thinking skills. Thinking critically by answering several questions and solving problems in everyday life and simultaneously making students able to relate initial knowledge to real life will make students more active in the learning process [26]. The findings of this study are consistent with research by [27], which claims that the problem-based learning model is highly effective in enhancing critical thinking skills because it is built around real-world problems, which facilitates students' comprehension of the subject matter, helps them develop their problem-solving and application skills, and helps them develop higher-order thinking skills. It has been reported that the scaffolding learning strategy is beneficial in enhancing students' critical thinking skills [28]. Applying the scaffolding method to learning can help students become more adept at critical thinking. This increase can be seen in the indicators of students' critical thinking skills. The first indicator regarding evaluating data validity has increased from 54 to 93. The second indicator, namely the need for more information for conclusions, has also increased from 55 to 98. The third indicator of critical thinking skills, namely, concluding correct statements, has risen from 51 to 87. Then, the fourth indicator, namely predicting the probability of events, also increased, which was initially 53 to 97. The fifth or final indicator of critical thinking skills, namely identifying alternative solutions in solving problems, also experienced an increase from 56 to 91. This increase can be seen from Figure 2 below:

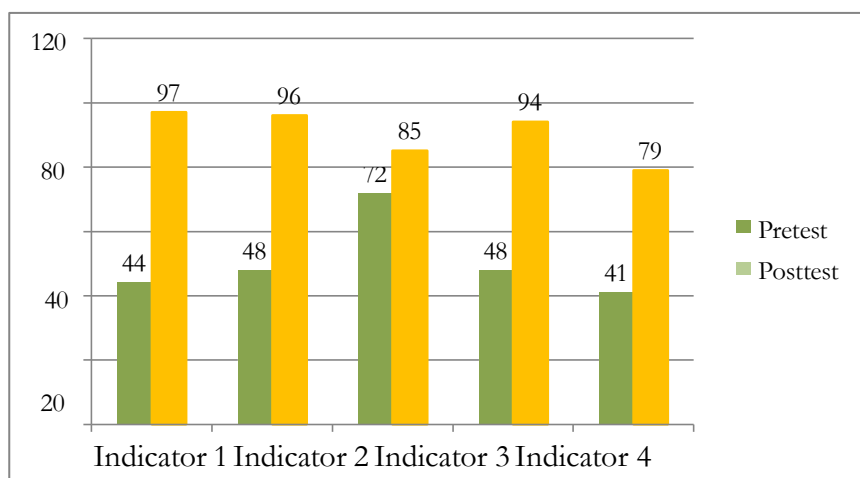


Figure 2. Increasing junior High School student's critical thinking skill

Figure 2. shows the increase in students' critical thinking skills. There are 5 indicators of critical thinking skills, each increasing in value. There are inhibiting and supporting factors for these five indicators. The indicators for evaluating the validity of the data are an inhibiting factor, namely when students have not mastered the material in the learning process, so the answer is still not valid for the truth. However, what supports it is that students have been given treatment that enables them to answer according to valid sources even though they are not perfect. The second indicator of obstacles is when students determine their information needs; they explain according to what they know without understanding the conclusions. However, as a supporter, they have answers that they know, so that they can provide various answers. The third obstacle indicator is that students cannot make conclusions based on the statements given. The fourth indicator that becomes an obstacle during the learning process is the students themselves because when learning takes place, the atmosphere in the classroom is not conducive. The support is based on the models and methods used as treatment so students can predict something about the material. The fifth indicator that is an

obstacle is that students still have difficulty making the most appropriate decisions to solve a problem. However, the support for this indicator is one of the students and school facilities. This value is taken from the student's pre-test and post-test. Students will respond to questions asked using appropriate responses. In the learning process, using the scaffolding method can direct students to connect the material with real life, and students will know how to discuss to determine problem-solving according to the student's level of awareness but following the collection of several information needs. The third indicator is concluding the correct statement; students get the lowest score. Students must still learn the statements correctly because they only say what they think when gathering information. However, in this case, all indicators of critical thinking skills improved significantly. Thus, implementing the Scaffolding method is very helpful in training students' critical thinking skills.

CONCLUSION

Based on the implementation of the scaffolding method in learning, there was an increase in seventh-grade junior high school students' critical thinking skills in the heat concept, getting an N gain value of 0.73. It can be concluded that the scaffolding method is very effective in improving junior high school students' critical thinking skills. The advice given to future researchers regarding this research is that students should be introduced to other learning models to get used to it; its implementation requires a pretty long time, and further research needs to be done on other science variables and concepts.

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