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Analysis of Students' Critical Thinking Abilities Together (NHT) Through the Numbered Heads Cooperative Learning Model on the Topic of Buffer Solutions

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The purpose of this study was to analyze the indicators of students' critical thinking skills through the NHT type cooperative learning model on the buffer solution material. The research subjects were 36 students of class XI MIA 2 academic year 2019/2020 at SMAN 45 Jakarta. The research was conducted using qualitative analysis methods by collecting data through observation, discussion sheets, critical thinking skills analysis tests, reflective journals, and student interviews. The research was carried out by applying the NHT cooperative learning model in four meetings through 5 stages of learning, namely conveying goals and motivating students, presenting information, organizing students into groups, guiding study groups, evaluating and giving awards. The results showed that the critical thinking skills of students mostly showed satisfactory criteria. This is evidenced by the achievement of satisfactory criteria on aspects of problem identification in questions, aspects of conceptual understanding, aspects of the ideas connection, aspects of assumptions and aspects of drawing conclusions. The application of the NHT type of cooperative learning model has a positive impact on the development of students' critical thinking skills through group discussion activities. The conclusion of the study shows that the critical thinking skills of students who achieve satisfactory criteria include three aspects including identification of the problem in question, conceptual understanding and drawing conclusions. Meanwhile, indicators that reach very good criteria contain aspects of the ideas connection and indicators that achieve unsatisfactory criteria contain aspects of assumption.

Keywords: Buffer solution, cooperative learning, critical thinking ability, numbered heads together

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1. INTRODUCTION

One of the goals of national education stated in Law of the Republic of Indonesia Number 20 of 2003 concerning the National Education System Chapter II Article 3 is to develop students' thinking abilities. So the government is making efforts to change the content-based learning system to competency-based learning. Competency-based learning includes four aspects of competency including spiritual, social, knowledge and skills competencies known as the 2013 Curriculum learning.

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The 2013 Curriculum learning approach is a student-oriented approach with the aim of creating active, innovative and conducive learning. This can encourage students to develop the skills they have.

The government hopes that the 2013 Curriculum can equip students with various abilities appropriate to the challenges of the 21st century, such as analytical, communication and thinking skills. However, in reality, the analytical and thinking abilities of Indonesian students are still relatively low. This is proven by the results of the 2018 PISA points. Indonesia experienced a decrease in points from 403 points (2015) to 396 points so that in 2018 Indonesia was in 73rd place out of 79 countries (Tohir, 2019).

Based on facts that occur in the field, the implementation of learning using the 2013 Curriculum has not run optimally. This is proven from the results of researchers' observations when carrying out PKM activities at SMA Negeri 45 Jakarta that in class learning students are only trained to answer questions quickly and accurately without being linked to the students' understanding. Apart from that, students are only focused on studying the questions that will be used for the exam later. This causes students to tend to memorize the material being studied without understanding it in depth. Other evidence can be seen from the use of learning models applied by teachers which are dominated by lecture methods rather than asking questions that can encourage students' thinking abilities. Thus, classroom learning is not directed at encouraging students' thinking abilities.

One effort that can be made to develop students' high-level thinking skills, especially critical thinking, is by choosing the right learning model. The cooperative learning model with the Numbered Heads Together (NHT) type can develop students' critical thinking skills. This is in line with research conducted by Ismaniati et al. (2019) with the results of their research showing that the application of visual-based NHT using worksheets can improve students' critical thinking abilities (Ismaniati & Jannah, 2019).

Other research was also conducted by Kawuwung (2014) with the results of his research namely that there was an influence on the NHT cooperative learning strategy on students' critical thinking abilities compared to conventional learning and the learning outcomes of students with low academics had increased due to their critical thinking abilities (Kawuwung, 2014).

Based on several previous research results, it can be said that the Numbered Heads Together (NHT) cooperative learning model is a learning model that emphasizes student activities in searching, processing and reporting information from various sources and presenting learning results in front of the class (Kagan, 1995).

In the NHT type cooperative learning model, students are more emphasized on working cooperatively with their group. This aims to enable students to develop their ideas or ideas in solving a problem so that it can encourage students' thinking abilities, especially critical thinking (Priansa, 2017).

Based on the explanations above, this research aims to analyze students' critical thinking abilities using the NHT type cooperative learning model on buffer solution material. According to Nurhidayatullah and Prodjosantoso (2018), their research showed that students' misconceptions regarding buffer solution material using a two-tier multiple choice diagnostic instrument were 47%, 37% understood the concept and 16% did not understand the concept. Misconceptions about buffer solution material often occur in the concept of calculating the pH of a buffer solution when adding a small amount of acid or base. Meanwhile, according to research conducted by Alighiri and Drastisianti (2018), it shows that students' conceptual



understanding of buffer solution material has not been maximally fulfilled. This is proven by the percentage results of 45.53% of students understanding, 31.05% not understanding, 12.96% having misconceptions and 10.46% not understanding.

This research will investigate indicators of students' critical thinking that emerge when studying buffer solution material through the Numbered Heads Together (NHT) cooperative learning model. Researchers hope that by implementing the NHT type cooperative learning model, students' critical thinking abilities can be observed optimally.

2. METHODS

The type of research carried out is qualitative research with data obtained in the form of images, sentences and words found in the field. The subjects of this research were 36 students of class XI MIA 2 SMA Negeri 45 Jakarta. In its implementation, this research applies the Numbered Heads Together (NHT) type cooperative learning model and refers to indicators of critical thinking skills according to SCIT1020 which include: (1) Identifying the problem in the question; (2) Conceptual understanding; (3) Relationships between concepts, (4) Assumptions and; (5) Conclusion. The data sources obtained in this research came from observer observation sheets, student group discussion sheets, student reflective journals, interviews and critical thinking ability analysis tests.

3. RESULTS AND DISCUSSION

In implementing classroom learning, the teacher applies the Numbered Heads Together (NHT) type cooperative learning model to the buffer solution material. Learning is carried out by creating small groups for students to actively discuss with their group friends in solving problems on group discussion sheets, so that learning can encourage students' thinking abilities, especially critical thinking. The learning process consists of 4 face-to-face meetings and 1 meeting to take a critical thinking analysis test.

3.1 Apperception Activities

3.1.1 First Meeting

At the first meeting, the teacher briefly explained the NHT type cooperative learning model to the students. The learning objective at today's meeting is to determine the components of a buffer solution. Then the teacher gives an apperception to the students.

Apperception Activities

Teacher: "Do you know what buffer solution means?"

1H: "based on the textbook, the definition of a buffer solution is a solution that can maintain pH."

Teacher: "What does maintaining pH mean?"

3F: "The pH hasn't changed ma'am"

1C: "The pH does not change too much ma'am, so the solution can maintain the pH"

Figure 1. First Meeting Apperception Activities



Based on the apperception activities, it can be said that some students tried to answer questions from the teacher. This is shown from the observation sheet written by the observer.

"Several students tried to answer the apperception questions given by the teacher."

(Observation Sheet 1, 18 February 2020)

The learning results at the first meeting showed that students were starting to be interested in using the NHT type cooperative learning model. One of the students wrote this in a journal reflection.

"In my opinion, this learning method can be easily understood with group collaboration"

(Reflective Journal, Student 3I, February 18 2020)

Apart from that, there were several students who asked questions and expressed their opinions in answering questions. This supports that the NHT type cooperative learning model can encourage students' critical thinking abilities.

3.1.2 Second Meeting

At the second meeting, the teacher explained the learning objectives that would be studied, namely knowing the role of buffer solutions in the human body, especially in the human mouth containing saliva. Then the teacher gives an apperception to the students

Apperception Activities

Teacher: "Does anyone still remember what the components of the buffer solution are?"

2G: "Acid buffer solution, ma'am, but I forgot the components."

4D: "I think the components are a weak acid and a conjugate base, ma'am."

3C: "I only remember the name of the solution, ma'am, namely phosphate buffer solution"

1B: "Weak acids and conjugate bases, ma'am."

Figure 2. Second Meeting Apperception Activities

Based on the apperception activities that have been carried out, it shows that there are several students who already understand the components of phosphate buffer solutions which consist of weak acids and conjugate bases. However, there are still some students who experience confusion.

The learning results at the second meeting showed that the students were very enthusiastic and enthusiastic in carrying out group discussion activities. This was stated by one of the students in an interview activity.

"The discussion activity made me and my group enthusiastic and enthusiastic, ma'am, so that my group was motivated to find answers, ma'am."



(1F Student Interview, March 6 2020)

Then several students were able to identify problems in the narrative text on the discussion sheet. During the question and answer session, one student gave a response. This is written down by the observer in the observation sheet.

"Students from Group E responded to the results of Group D's discussion" (Observer Observation Sheet 2, 19 February 2020)

Based on these findings, it can be proven that the NHT type cooperative learning model is able to encourage students' critical thinking abilities. The indicators of critical thinking that emerge are identifying the problem in the question and formulating the problem.

3.1.3 Third Meeting

At the third meeting, the teacher explained the learning objectives that would be studied, namely explaining the working principle of buffer solutions in controlling the pH of the solution, especially in maintaining the pH in the mouth. Then the teacher gives an apperception to the students.

Apperception Activities

Teacher: "Do the children remember what the function of the buffer solution in our mouths is?"

1G: "Buffer solutions function to stabilize the pH in the mouth."

2I: "Functions to neutralize the condition of the mouth, ma'am, so that our mouth doesn't taste too sour due to consuming fizzy drinks"

Figure 3. Third Meeting Apperception Activities

Based on the apperception activities that have been carried out, it shows that several students already understand the function of the buffer system in the mouth.

The learning results at the third meeting showed that students were enthusiastic and enthusiastic in carrying out group discussion activities. Students write this down in a reflective journal sheet.

"The learning method is very fun, makes fellow friends happy and is easy to understand. We can find out about buffer solutions."

(Reflective Journal, Student 3I, February 26 2020)

Then several students were able to connect the concepts of acid and base in writing the working principles of buffer solutions, were able to provide assumptions and draw conclusions in narrative texts. During the question and answer session, there were two students who provided responses. The observer wrote this down in the observation sheet.

"Students in groups D and F seemed quite active in discussing, while in group E there were students who were just silent."

(Observation Sheet 2, 26 February 2020)



"All members of groups G, H and I are active in discussions" (Observation Sheet 3, 26 February 2020)

Based on these findings, it is proven that the learning activities at the third meeting were able to encourage students' critical thinking abilities. The critical thinking indicators that emerge are the relationships between concepts, assumptions and conclusions.

3.1.4 Fourth Meeting

At the fourth meeting, the teacher explained the learning objectives that would be studied, namely determining the pH value of a buffer solution and its changes using the acid-base concept. Then the teacher gives an apperception to the students.

Apperception Activities

Teacher: "Do the children still know what pH is?"

4A: "pH is the degree of acidity, ma'am."

Teacher: "What information can pH data show in a solution?"

4G: "Values are numbers, ma'am."

2A: "The acidic strength of a solution, ma'am."

Figure 4. Fourth Meeting Apperception Activities

Based on the apperception activities that have been carried out, it produces answers that show that students already understand the meaning of pH but cannot yet direct it to the topic of the problem.

The learning results at the fourth meeting showed that students were able to provide assumptions in determining the pH value of the buffer solution. Most students actively contributed to the question and answer session by asking questions. This proves that learning activities can encourage students' critical thinking skills, especially on assumption indicators.

3.2 Analysis of Students' Critical Thinking Abilities

In carrying out analysis activities, students' critical thinking skills on buffer solution material are focused on five indicators according to SCIT1020 developed by White et al. (2011) includes indicators of problem identification in questions, conceptual understanding, relationships between concepts, assumptions and conclusions

3.2.1 Identify the Problem in Question

This ability influences a person to be able to identify and formulate questions to consider possible answers. Based on the results of students' answers from the critical thinking analysis test, it produces a graph that depicts the problem identification indicators in the question.



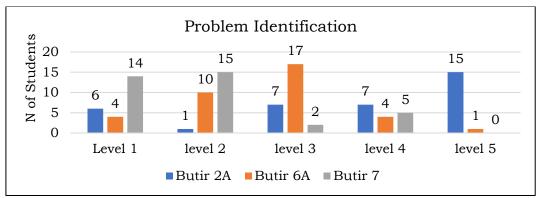


Figure 5. Problem Identification Indicator

Based on the picture above, it shows that the majority of students' answers reached level 3 (Satisfactory).

So it can be concluded that students' critical thinking abilities with the problem identification indicators in the questions are at a satisfactory level. This finding is in line with research conducted by Parameswari and Azizah (2020) which revealed that the NHT learning model is effective for improving students' critical thinking skills, that critical thinking is quite good among students, perhaps because students are actively involved during NHT learning activities. so that they are able to identify and formulate each problem (Pradnya Parameswari & Utiya Azizah, 2020).

3.2.2 Conceptual Understanding

This ability explains clearly and effectively an event by using the concepts it has to solve certain problems. Based on the results of students' answers from the critical thinking analysis test, they produce graphs that depict indicators of conceptual understanding.

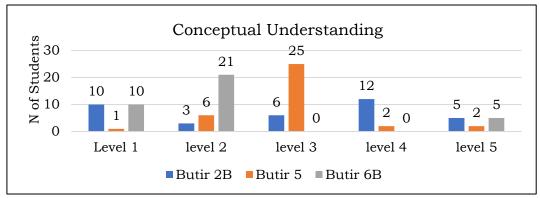


Figure 6. Conceptual Understanding Indicator

Based on the picture above, it shows that the majority of students' answers reached level 3 (Satisfactory).

So it can be concluded that students' critical thinking abilities with indicators of conceptual understanding are at a satisfactory level, meaning that the majority of students in answering questions are able to respond with satisfactory concepts. This finding is in line with research conducted by Kawuwung (2014) which states that NHT learning strategies have an effect on increasing students' critical thinking abilities, that group discussion activities can build students' understanding



independently so that students' conceptual understanding can develop (Kawuwung, 2014).

3.2.3 Relationship Between Concepts

This ability measures students' critical thinking abilities in relating the questions given to other concepts so that the answers to the concepts used are interconnected. Based on the results of students' answers from the critical thinking analysis test, they produce graphs that depict indicators of relationships between concepts.

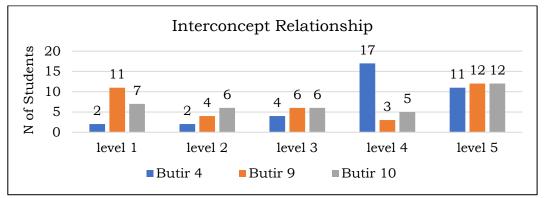


Figure 7. Interconcept Relationship Indicator

Based on the picture above, it shows that the majority of students' answers reached level 5 (Excellent).

So it can be concluded that students' critical thinking skills with indicators of relationships between concepts are at a very good level. This finding is in line with research by Dadri et al. (2019) who explained that the application of the NHT type cooperative learning model can help students to improve their thinking abilities and cognitive processes in solving a problem and be able to connect various information from the knowledge they have to create a formulated final result (Dadri et al., 2019).

3.2.4 Assumptions

This ability measures students' critical thinking abilities in providing opinions or ideas on the questions given. After understanding the concepts and connecting the concepts well, it is hoped that students can make good assumptions too. Based on the results of students' answers from the critical thinking analysis test, they produce graphs that depict assumption indicators.

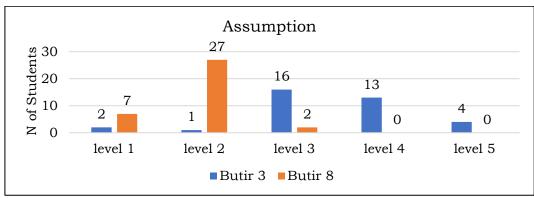


Figure 8. Assumption Indicator



Based on the picture above, it shows that the majority of students' answers reached level 2 (Marginal Pass).

So it can be concluded that students' critical thinking abilities with assumption indicators are at an unsatisfactory level. This is in line with research by Febrianti (2020) which states that the NHT model is very effective for training students to become critical people. This certainly encourages students to provide careful assumptions that are supported by consistent justification (Febrianti, 2020).

3.2.5 Conclusion

This ability measures students in making well-reasoned conclusions from a problem. Based on the results of students' answers from the critical thinking analysis test, they produce graphs that depict conclusion indicators.

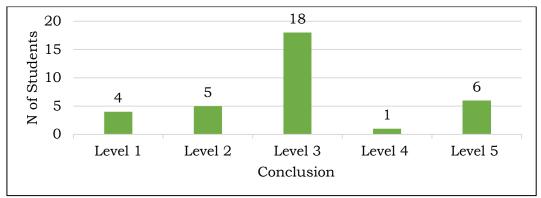


Figure 9. Conclusion Indicator

Based on the picture above, it shows that the majority of students' answers reached level 3 (Satisfactory).

So it can be concluded that students' critical thinking abilities with indicators of drawing conclusions are at a satisfactory level. This is in line with research by Gillespie (2011) which states that students who have critical thinking skills can draw conclusions with the right reasons (Gillespie, 2011).

4. CONCLUSION

Based on research conducted in class In its implementation, the learning that has been carried out is able to encourage students' critical thinking skills to become more focused. This is shown by students becoming more active in responding to questions from the teacher, because students are required to express their opinions or ideas in solving existing problems.

Based on the results of the critical thinking analysis test, it shows that students' critical thinking abilities at level 5 with a very good level category contain indicators of relationships between concepts. Meanwhile, indicators at level 3 in the satisfactory level category include indicators for identifying the problem in the question, conceptual understanding and conclusions. And indicators at level 2 in the unsatisfactory level category contain assumption indicators.

Conflict of Interest

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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