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Analysis of the Critical Thinking Skills of Students in Senior High School in Solving the Reaction Rate Problem

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Abstract

This study aimed to obtain a description of the critical thinking skills of SMA Negeri 3 Palu students in solving reaction rate problems. The type of research used is descriptive-quantitative, with the research design in the form of case studies. The research sample consisted of students of class XI IPA 1 to XI IPA 4 SMA Negeri 3 Palu, with 108 students. The research instrument used is a critical thinking skill test in the form of 6 questions, validated with a value obtained for expert validation of 3.72 and an average empirical validation value of 0.72. Data analysis is done by calculating the grades students get for each indicator of critical thinking skills, then grouping them by essential categories of thinking. According to Ennis, the indicators of critical thinking skills used in this study are to provide simple explanations, build basic skills, draw conclusions, provide further explanations, and set strategies and tactics. Based on the results of the research data analysis, the highest percentage of critical thinking skills for the five indicators used in a row, namely 37.04, 51.85, 61.11, 53.70, and 42.59 %. These results show that each student has different critical thinking skills. The percentage obtained is, on average, in the medium to high category. The results of this study show that the essential thinking skills of high school students of SMA Negeri 3 Palu, grade XI IPA, are in a good category.

Keywords: Analysis, critical thinking, reaction rate

Introduction

Chemistry learning is often considered difficult, uninteresting, and unimportant by students. Wahyuni et al. (2015) support this statement by stating that chemistry is a subject that is considered difficult for students. Based on this reality, it is necessary to change students' paradigms about chemistry lessons. Teachers must convey that chemistry is important to learn because it is closely related to human life.

Reaction rate material is one of the most important chemical materials to study because it relates to human life. In explaining the reaction rate material, teachers must convey its benefits in daily life so that students feel it is important to teach it. Cagatay & Demircioglu (2013) State that one of the goals of chemistry learning is to help students use the knowledge gained in school to explain phenomena that occur in daily life.

Chemistry learning related to problems or phenomena in daily life requires students' thinking skills. According to Komariyah & Laili (2018), thinking is a human activity that transforms information in memory to form concepts, reason, think critically, and solve problems. According to Ennis (2011), critical thinking is reasoned and reflective thinking that emphasises making decisions about what to believe or do.

Critical thinking skills can also be interpreted as students' ability to identify and formulate a problem, which includes determining the essence, finding similarities and differences, exploring relevant information and data, the ability to consider and assess which includes distinguishing between facts and opinions, and finding assumptions, as well as drawing conclusions that can be held accountable (Yunita et al., 2018). Critical thinking indicators are classified into five categories according to Ennis (1985), namely: Providing simple explanations (*elementary clarification*), building basic skills (*basic support*), concluding (*inference*), providing further explanations (*advanced clarification*), and setting strategies and *tactics*.

Astuti et al. (2018) argue that teaching and developing critical thinking skills is seen as very important in schools so that students are able and accustomed to facing various problems around them. This shows that critical thinking skills are important to develop starting from the most basic level of education.

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The critical thinking skills of Indonesian students are still below international standards. This is based on the results of a study by TIMSS (*Trends in International Mathematics and Science Study*), published by the Ministry of Education and Culture, showing that Indonesia's score is still below the international average score. As a result of the 2003 TIMSS study, Indonesia is ranked 35th out of 46 participating countries with an average score of 411, while the international average score is 467. The results of the 2007 study showed that Indonesia was ranked 36th out of 49 participating countries with an average score of 397, while the international average score was 500. According to the 2011 TIMSS study results, Indonesia is ranked 38th out of 42 participating countries with an average score of 386, while the international average score is 500. According to the 2015 TIMSS study results, Indonesia is ranked 44th out of 49 participating countries with an average score of 397, while the international average score is 500 (Hadi & Novaliyosi, 2019).

Conditions that are not much different can be seen from the results of a study conducted by PISA (*Programme for International Student Assessment*). The results of the 2009 PISA study show that Indonesia is ranked 60th out of 65 participating countries with an average score of 383, while the international average score is 500. According to the 2012 PISA study results, Indonesia is ranked 64th out of 65 participating countries with an average score of 382, while the international average score is 500. As a result of the 2015 PISA study, Indonesia is ranked 62nd out of 69 participating countries with an average score of 403, while the international average score is 500. As a result of the 2018 PISA study, Indonesia is ranked 70th out of 78 participating countries with an average score of 396, while the international average score is 500 (Pertiwi, 2019).

Studies conducted by TIMSS and PISA show that Indonesia's score is still below the international average. The questions used by TIMSS and PISA consist of problems that are not routine to measure high-level thinking skills. Students are required to think critically and creatively when dealing with these problems. The results of the TIMSS and PISA studies show that the critical thinking skills of Indonesian students are still relatively low (Afriyanti et al., 2018).

This condition is also seen in one of the high schools in Palu, namely SMA Negeri 3 Palu. Based on the results of an interview with one of the chemistry teachers of class XI science at SMA Negeri 3 Palu, it was said that one of the main materials considered difficult by students was the reaction rate material. This can be seen from the daily test scores of the odd semester reaction rate of grade XI science for the 2019 / 2020 school year, where less than 50 % of students were declared complete without remediation. This indicates that the level of difficulty in the reaction rate material is still very high. Because of differences in students' cognitive levels, teachers' academic abilities, and other individual differences, there are differences in the interpretation of a certain concept. Based on this, this paper is intended to obtain a description of the critical thinking skills of SMA Negeri 3 Palu students in solving the problem of reaction rate.

Methods

This research activity was carried out at SMA Negeri 3 Palu, in classes XI Science 1 to XI Science 4, with a sample of 108 students. The sample collection technique used is *purposive sampling*, which looks at the teacher's ability to teach each class so that the students' critical thinking skills can be predicted.

The test instrument used in this study aims to measure students' critical thinking skills in solving problems in the Reaction Rate material. According to Ennis, the number of questions used is six items, which cover all critical thinking indicators. This test instrument was developed by adapting from the Chemistry Class XI Curriculum 2013, revised edition 2016, and has been validated theoretically and empirically with an average validation value of 0.72.

The data analysis technique in this study is a descriptive analysis of critical thinking. It calculates the number of scores obtained by students, indicators of critical thinking from each problem item, and divides them by the maximum number of scores. Furthermore, students' abilities are categorised into five categories: very low, low, medium, high, and very high (Panadero & Lipnevich, 2022).

Results and Discussion

The data obtained in this study is the data from the analysis of critical thinking skills of grade XI science students at SMA Negeri 3 Palu on the Reaction Rate material that has been adjusted to the indicators of critical thinking skills according to Ennis (1985), namely providing simple explanations, building basic skills, drawing conclusions, providing further explanations, setting strategies and tactics. The concept contained in the Reaction Rate material is to analyse the factors that affect the reaction rate and calculate the rate of the reaction based on experimental data. The results of the analysis of students' critical thinking skills for each indicator are outlined in **Figure 1-5**.

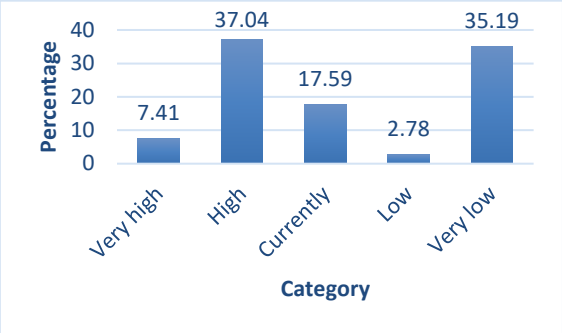

Figure 1. The percentage of students based on critical thinking categories provides a simple explanation

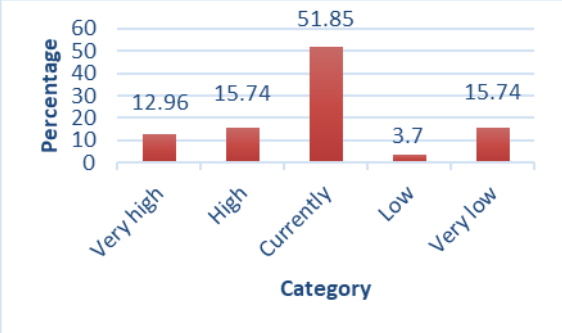

Figure 2. The percentage of students based on critical thinking categories builds basic skills

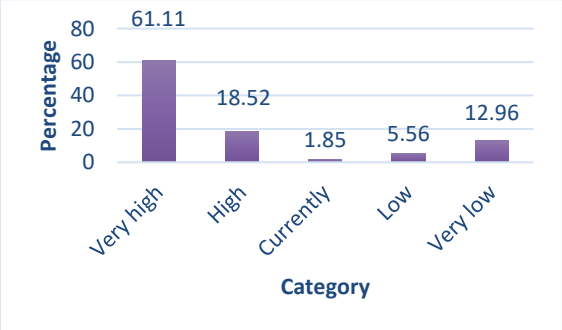

Figure 3. The percentage of students based on critical thinking categories concluded

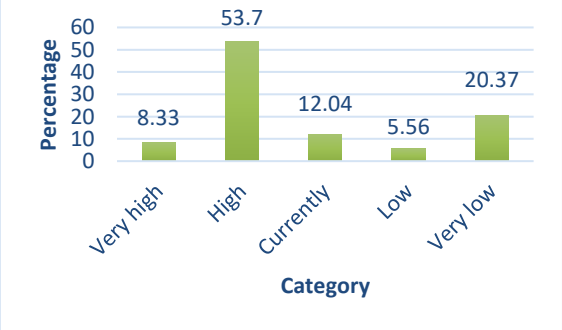

Figure 4. Percentage of students based on critical thinking categories

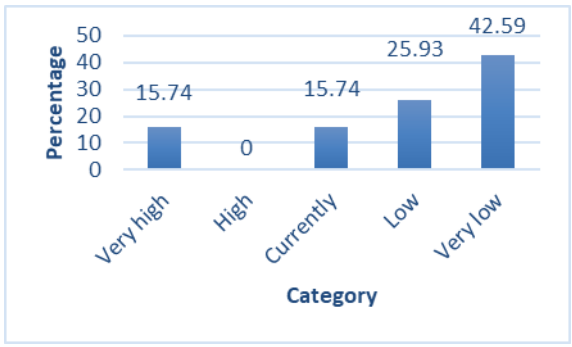

Figure 5. Percentage of students based on critical thinking categories, organizing strategies, and tactics

The data in **Figures 1-5** show that, in general, the critical thinking skills of students in grade XI Science of SMA Negeri 3 Palu on the Reaction Rate material are good. This can be seen in the results obtained, where each critical thinking indicator obtained has an average percentage above the medium category.

The analysis of critical thinking skills from all indicators showed that the highest percentage obtained differed for each indicator. The first indicator, which is to give a simple explanation, has the highest percentage of 37.04 % which is in the high category, for the second indicator, namely building basic skills, has the highest percentage of 51.85 % which is in the medium category, for the third indicator, which is to conclude that it has the highest percentage of 61.11 % which is in the very high category, for the fourth indicator, which is to make further explanations have the highest percentage 53.70 % which is in a high theory, and for the fifth indicator, namely setting strategies and tactics, has the highest percentage of 42.59 % which is in the very low category.

Each indicator obtained has the highest percentage in different critical thinking categories. This shows that students' critical thinking skills are different. Nugraha et al. (2017) State that a person who is said to be a critical thinker does not have to meet all indicators of critical thinking as a critical thinking skill in cognitive abilities. So, to see a person's critical thinking skills, one can choose one of several indicators according to the focus of the discipline to be studied.

Critical thinking skills are among the higher-level thinking skills that require students to be active learners because students can analyse, evaluate, and create (Stedman & Adams, 2012). Critical thinking aims to enable students to transfer abstract principles by applying them in everyday life (Elder & Richard, 2013). Critical thinking is important for a person to meet the ever-changing personal, social, and professional demands in society (Che, 2002).

Students' critical thinking skills will develop if the efforts made by the teacher support them.

This higher-level thinking exercise needs to be designed by teachers as a student learning experience, so that students can solve a problem with ideas without having to create new problems (Yunita et al., 2018). In addition, education today is very necessary to train students to have the ability to think critically so that they can behave and adapt effectively in facing the challenges and demands of daily life (Rahmawati et al., 2016).

Critical thinking is very important for educational settings because with critical thinking skills, students are able to generate new insights, new perceptions, and deep responses (Dil et al, 2015). This is because critical thinking skills are closely related to the world's dynamic, fast-changing, and unpredictable situation. Based on the research of Sellars et al. (2018), it is emphasized that critical thinking skills are needed so that students can manage and utilize information to survive in an ever-changing, uncertain, and competitive situation. This is in accordance with Azizah et al. (2016), who argue that teaching and developing critical thinking skills is seen as something very important to be developed in schools so that students are able and accustomed to facing various problems around them.

Conclusions

Students' critical thinking skills in the Reaction Rate material are generally good because the average is in the medium to high category. Students of SMA Negeri 3 Palu have different percentage categories, different from each critical thinking indicator. This shows that each student has different critical thinking skills. This difference in critical thinking skills indicates the need to apply critical thinking in every learning process at school, so that students can get used to the application of critical thinking.

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