# Analisis Buku Bab Kimia Kelas XI SMA/MA pada Materi Laju Reaksi Berdasarkan Muatan Literasi Sains

## *Analysis of Chapter Book Chemistry Class XI SMA/MA on Reaction Rate Material Based on Science Literacy Content*

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## ABSTRACT

*Textbooks are the main operational instrument for curriculum implementation. The Merdeka curriculum focuses on literacy in various aspects, one of which is science literacy. Science literacy is the capacity to comprehend, apply, and use science to solve problems efficiently and responsibly by using scientific principles. Chemistry book class XI SMA / MA Merdeka curriculum is the main textbook issued by the Kemendikbud in 2022 and must be used in educational units. The purpose of this study is to describe the balance of science literacy content presented in the chemistry textbook class XI SMA/MA Merdeka curriculum on reaction rate so that it will be known whether the main textbook has represented the objectives of the Merdeka curriculum. The research method used is descriptive research with a qualitative approach. The results showed that the four categories of science literacy have been presented, however, it has not shown a balanced proportion between the four categories of science literacy. The percentage of occurrence of the four categories of science literacy, namely science knowledge by 53.85%; investigation of the nature of science by 35.39%; science as a way of thinking by 9.23%; and the interaction of science, technology, and society by 1.54% with a ratio of 35:23:6:1.*

## ABSTRAK

Buku teks merupakan instrumen operasional utama dalam implementasi kurikulum. Kurikulum Merdeka menitikberatkan pada literasi dalam berbagai aspek, salah satunya literasi sains. Literasi sains adalah kemampuan memahami, menerapkan, dan menggunakan sains untuk memecahkan masalah secara efisien dan bertanggung jawab dengan menggunakan prinsip-prinsip ilmiah. Buku Kimia Kelas XI SMA/MA Kurikulum Merdeka merupakan buku ajar utama yang diterbitkan Kemendikbud pada tahun 2022 dan wajib digunakan di satuan pendidikan. Tujuan penelitian ini adalah untuk mendeskripsikan keseimbangan muatan literasi sains yang disajikan pada buku teks kimia kelas XI SMA/MA Kurikulum Merdeka tentang laju reaksi sehingga akan diketahui apakah buku teks utama sudah mewakili tujuan kurikulum Merdeka. Metode penelitian yang digunakan adalah penelitian kualitatif. Hasil penelitian menunjukkan bahwa keempat kategori literasi sains telah tersaji, namun belum menunjukkan proporsi yang seimbang antara keempat kategori literasi sains. Persentase terjadinya empat kategori literasi sains yaitu pengetahuan sains sebesar 53,85%; penyelidikan hakikat ilmu sebesar 35,39%; sains sebagai cara berpikir sebesar 9,23%; dan interaksi ilmu pengetahuan, teknologi, dan masyarakat sebesar 1,54% dengan rasio 35:23:6:1.

# 1.  INTRODUCTION

The 21st century, in which education is practiced today, is distinguished by the quick advancement of science and technology (Sutrisna, 2021; Hanifa, et al. 2021). In this century, the demands for quality human resources are getting higher (Hanifa, et al. 2021). One of the abilities demanded in this century is scientific literacy (Kahar et al. 2021). Science literacy is the ability to understand science concepts and principles using science-related skills, attitudes, and knowledge to think critically, solve problems, and make the decisions needed to solve science-based problems (Sutrisna, 2021). The proper science learning process will help students in mastering science literacy (Toharudin et al. 2011).

Indonesia has participated in an International program that could measure students' science literacy. The Organization for Economic Cooperation and Development (OECD) administers the Programme for International Student Assessment (PISA), an International program that tests students' skills and knowledge in reading, mathematics, and science literacy to assess educational systems globally (Sujadi et al. 2022; Setyawarno et al., 2021). PISA collects reliable information to compare the reading literacy, math literacy, and science literacy of students in a country with other participating countries and understand the strengths and weaknesses of each country's education system (Fitriyah, 2020).

The results of the last three years of PISA, which have been followed by Indonesia, show that the low science literacy of students is evidenced by the acquisition of Indonesia's score which is below the PISA completion score (OECD, 2019). In 2012, Indonesia was in 64th position out of 65 countries with an average score obtained of 382, in 2015, Indonesia was in 62nd position out of 69 countries with an average score obtained of 403, in 2018, Indonesia was in 75th position out of 80 participating countries with an average score of 396 (OECD, 2019).

The low science literacy of students in Indonesia is due to several factors (Sutrisna, 2021) namely the curriculum or educational system, the choice of instructional strategies and models, the facilities and infrastructure, and the instructional materials—textbooks—that are utilized as learning tools. Indonesia is among the lowest 10 countries in the world for science literacy achievement among students, even though science literacy is a crucial indicator of a nation's educational quality (Pratiwi et al., 2019; Hewi et al, 2020). Indonesia altered its strategies to raise the standard of education in the country in reaction to the PISA study's findings. The Indonesian program aims to modify the current curriculum (Fitriyah, 2020).

The emphasis on core subjects and the stages of competency development for students are two advantages of the Merdeka curriculum, which allow students to study more thoroughly, meaningfully, joyfully, and slowly. Project-based learning makes learning far more engaging

and relevant, and it provides students with more chances to actively investigate real-world problems including those about the environment, health, and other topics. One of the goals of this teaching approach is to improve students' literacy in every topic (Rahmadayanti,et al. 2022).

The changes in the curriculum resulted in changes in the use of teaching materials, especially textbooks used to adjust to the curriculum (Rosa, 2021). Textbooks are the learning instruments provided by the government to support the implementation of the Merdeka curriculum in schools (Rahmadayanti, et al. 2022). Textbooks in the Merdeka curriculum are divided into two categories: main textbooks and companion textbooks (Rahmadayanti & Hartoyo, 2022). According to Permendikbudristek Number 22 of 2022, the primary textbook is one that the central government provides gratis and is mandated to be used for instruction based on the relevant curriculum. Administrative penalties apply to educational entities that do not employ official textbooks, as stated in Indonesian Law Number 3 of 2017 addressing the book system.

The chemistry book for class XI SMA/MA whose contents are adapted to the times and technology and discuss the relationship between chemistry and everyday life. It is something that refers to science learning which is an important factor in the development of science literacy. However, the content of science literacy categories presented in it needs to be considered (Septia Marisa et al., 2021). Science textbooks that are compiled based on science literacy content must have a balanced proportion of the appearance of science literacy categories. The book's proportion of science literacy has to be balanced since it will have an impact on students' learning preferences and the classroom learning environment. It is concerning, then, that science education primarily concentrates on science information rather than developing scientific inquiry or critical thinking skills. Students will find it challenging to apply science in real life and will have poor science, technology, and society interaction abilities when these processes are low (Nufikasari et al., 2022).

Chiappetta et al. (1991), identified four categories of science literacy that are used to analyze science textbooks: science knowledge, science as an investigative approach, science as a style of thinking, and science, technology, and society interaction. A textbook should contain 42% aspects of science knowledge, 19% aspects of the nature of science investigation, 19% aspects of science as a way of thinking, and 20% aspects of the interaction of science, technology, and society. The ratio for the four categories of science literacy in a row should be 2:1:1:1, or there should be a negligible percentage difference (Wilkinson,1999)

Research related to the analysis of chemistry textbooks XI SMA / MA has been done and shows that chemistry textbooks do not have a balanced proportion, namely research by Devia Mentari Putri (2022) by analyzing chemistry textbooks SMA / MA class XI of the

2013 curriculum found that the books used are more oriented to the category of science as a body of knowledge and have not shown a balanced proportion. However, the analysis of chemistry textbooks for grade XI SMA/MA independent curriculum based on the content of science literacy, especially on reaction rate material, has not been done. Therefore, it is important to analyze the chemistry textbook for grade XI SMA/MA of the independent curriculum based on the four categories of science literacy on reaction rate material so that it is known how the balance of science literacy categories is presented so that it can be seen whether the book issued by the Ministry of Education and Culture has represented the nature of science literacy and the objectives of the independent curriculum.

## 2. METHOD

The research type used in this research is descriptive qualitative research. Descriptive research is a research method that describes an object (Syaodiah Sukmadinata, 2009). Qualitative research methods are used to obtain in-depth data or data that has meaning rather than generalized data (Sugiyono, 2012). The object of this research is the chemistry chapter book for class XI SMA/MA Merdeka curriculum published by Kemendikbud in 2022 on reaction rate material. The data collection technique used is documentation. Documentation is a data collection technique by obtaining data and information through documents (Sugiyono, 2012). The technique of data analysis uses Milles and Huberman techniques with the software tools Quirkos. The instrument that was used to obtain the data was a documentation sheet analyzing the category of science literacy from Chiappetta et al. (1991). The results of the data analysis will be tested for reliability by two chemistry lecturers at Padang State University. The checking data has calculated the level of reliability to obtain the observer agreement coefficient with the formula:

$$KK = 2S/(N_1 + N_2)$$

(Arikunto, 2010)

The results of the calculation of the observer agreement coefficient are then recapitulated based on the following categories

| Percentage range of approval results | Categories |
|---|---|
| >75% | Very Good |
| 40%-75% | Good |
| <40% | Very bad |

The results of checking by two expert observers will be reviewed on the results of the analysis of science literacy categories. Furthermore, the percentage of occurrence of each indicator is calculated using the formula:

$$\% = \frac{number\ of\ indicators\ per\ category}{number\ of\ indicators\ total\ category} \times 100\%$$

The data was then drawn based on the proportion of balance according to Wilkinson (1999), namely in the category of science knowledge by 42%, science investigation by 19%, science as a way of thinking by 19%, and the interaction of science, technology, and society by 20%. If a comparison is made for the four categories in a row is 2: 1: 1: 1.

## 3. RESULT AND DISCUSSION

### 3.1. Research Results

The research data is in the form of the percentage of the observer agreement coefficient and the appearance of science literacy indicators in the chemistry chapter book class XI SMA / MA Merdeka curriculum on reaction rate material. Based on the results of the study, the observer agreement was 0.91 with a very good category. The display of data on science literacy categories using quirkos can be seen in Figure 1.
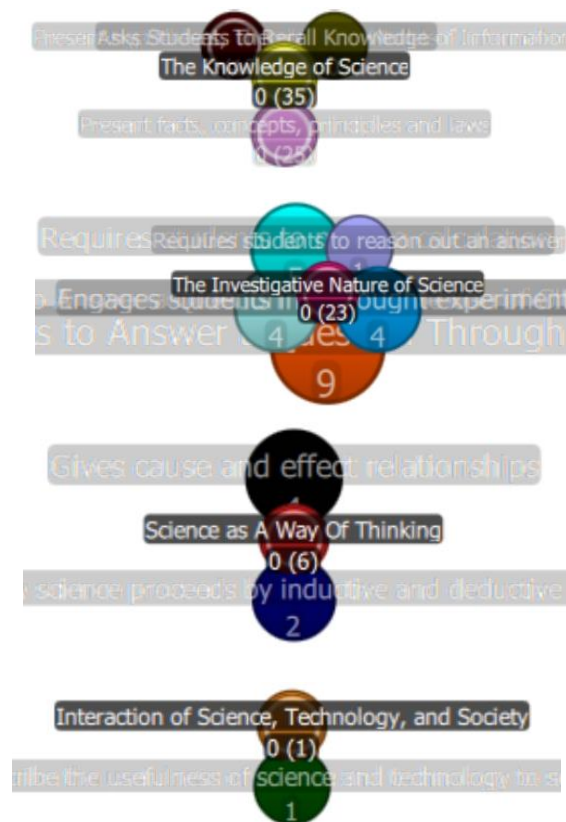


Figure 1. The results of displaying data using Quirkos

The results of Figure 1 show that the science knowledge category is the most dominant in the chemistry chapter book for grade XI SMA/MA while the science, technology, and society interaction category is the least science literacy category. The huge percentage difference shows that the proportion of science literacy categories is not balanced. In addition, the comparison between science literacy categories in the chemistry chapter book grade XI SMA/MA does not

have a ratio of 2:1:1:1. However, the four categories of science literacy have appeared in the chemistry chapter book of grade XI SMA/MA on reaction rate material, namely science knowledge, studying the relationship between science, technology, and society as well as the nature of science and science as a style of thinking.

## 3.2 The Knowledge of Science

Science knowledge is knowledge that has undergone testing of its truth through the scientific method that can be repeated by others repeatedly (Toharudin et al., 2011). The purpose of the text is to provide, discuss, or require students to recall data, facts, concepts, laws, theories, and models is referred to as the science knowledge category. This category represents the information that is provided so that students can learn (Chiappetta et al., 1991).

This category has the highest percentage of occurrence. However, this category is important because by using scientific knowledge to understand a phenomenon, learners will be able to make decisions to solve problems (Septia Marisa et al., 2021). A more dominant category of science knowledge will cause learners to be skilled only in terms of remembering (Rosa, 2021). In addition, it will create a lack of motivation for students to learn about science (Rizki Andita Wijayanti et al., 2023).

The results of the study showed that the indicators that appeared in the science knowledge category were indicators of presenting facts, concepts, principles, and models. The sub-indicator that appears the most is the principle sub-indicator with 12 statements. Principles include postulates, formulae, adages, postulates, paradigms, theorems, and links between ideas that define causal implications. Principles are the major things, the most significant things. (Iriani & Ramadhan, 2019). This is because the material analyzed presents calculation material content related to formulas. While the indicator of asking students to recall knowledge or information does not appear, even though this indicator is important for students because it can help students construct old knowledge that has been learned with new knowledge to be learned (Rizki Andita Wijayanti et al., 2023). This material has prerequisite material, namely stoichiometry material, especially about molarity which has been learned and must be mastered by students so that students can easily calculate the reaction rate.

## 3.3 The Investigative Nature of Science

The investigative nature of science is the process of proving the theoretical knowledge of science including scientific knowledge, principles, scientific methods, scientific theories, and laws (Wangchuk et al., 2023). The science inquiry category describes the text's goal of encouraging students to think critically and take action by posing questions for them to research. The active components of inquiry and learning are reflected in this category, which involves students using science

process techniques such as data recording, measurement, classification, inference,experimentation, and observation.

This category has the second-highest percentage of occurrence at 35.39%. This category has a percentage of occurrence that is not much different from the science knowledge category so this book can be used as teaching material that can develop students' abilities because it can hone students' skills. This category is important for learners because learners can apply science skills in solving existing problems and can make decisions based on scientific considerations not just knowing concepts (Rizki, A et al., 2023).

The most common indicators in this category are those that urge students to use up to nine statements of material to answer questions and five statements that call for calculation from the students. This is because the material analyzed presents material content that contains theory with calculations. However, four statements serve as indicators, asking students to respond to questions using tables, charts, and other visual aids. This shows that the analyzed book has adjusted to the presentation of questions based on PISA, namely the ability to answer questions using charts or tables, although the occurrence is still small.

Indicators that involve students in conducting experiments or thinking activities have an indicator occurrence of four statements. This indicator allows students to prove concepts or theories in the book so that students can experience the process themselves and draw conclusions from activities that support understanding. With this category, students will more easily master concepts through process skills that can be developed by investigating the nature of science because the learning process with a science skills approach can emphasize concepts or understanding (Rosa, 2021). Indicators that require students to explain an answer have the least occurrence in this category, namely one statement. Even though this indicator can stimulate students' reasoning power. This indicator can encourage students to be skilled in solving problems that require deeper understanding so that students' critical thinking skills can increase.

Rakhmawati in Rosa (2021) stated that students are more interested in science when conducting experiments in the laboratory. With this science textbook that contains experimental activities that encourage students' science skills and does not only focus on presenting science knowledge, it is hoped that it will increase students' motivation to learn science and improve students' understanding of science learning.

## 3.4 Science as a way of thinking

Science as a way of thinking refers to a rational scientific activity that involves the mind to reason (Toharudin et al., 2011). The purpose of the text to demonstrate how science in general or specific scientists in particular gain information is referred to as

this type of science literacy (Chiappetta et al., 1991). This category had the third most occurrences. The percentage of occurrence of this category is very much different from the previous two indicators, namely science knowledge and investigating the nature of science. This indicates that the textbook does not provide the means for students to develop thinking skills. However, this is reasonable to find because such content will be obtained more in investigating the nature of science in the form of conducting practicum or experiments rather than being presented in books (Septia Marisa et al., 2021).

The indicator that appears most in this category is providing a causal relationship in as many as 4 statements. This indicator can encourage students to look for relationships between scientific phenomena and the information obtained (Rosa, 2021). Indicators that appear in this category are indicators that show how science processes with inductive and deductive reasoning. This indicator is important because it can improve students' logical thinking skills. The following indicators do not fall under this category: explaining how a scientist conducts experiments; demonstrating the evolution of an idea; stressing the objectivity and empirical character of science; demonstrating the use of assumptions; talking about proof and evidence; and outlining the scientific method and problem-solving techniques. This indication can help students become more adept at critical thinking, logical reasoning, initiative, and adaptation to changes and advancements, all of which are crucial for improving their science literacy. Consequently, the category of science should be included in scientific textbooks as a style of thinking so that students may build critical thinking abilities that will positively affect the development of their insights and abilities to identify connections between science and other subjects.

### 3.5 Interaction of Science, Technology, and Society

Science, technology, and society interact when individuals (the community) are involved in the advancement of science and technology (Bijker, 2001). According to Chiappetta et al. (1991), this category relates to the text's purpose to show how science affects society. Because it may pique students' interest in studying science, this category is crucial for education. Based on the research findings, however, this category has the fewest occurrences—just one remark is included in the indication that characterizes how beneficial science and technology are to society. However, this textbook does not provide data about occupations and employment in the field of science and technology, science and technology-related societal problems, or indicators demonstrating the detrimental effects of science and technology on society. On the other hand, this substance is heavily utilized in daily life.

Therefore, it is expected that the textbook can be a medium that encourages students to be involved in the development of technology that can be used to solve problems in everyday life. In addition, textbooks should also contain content that can be used as an encouragement for learners to discuss social issues in society to find out what science and technology need to be developed so that learners' skills in making decisions on a problem will increase. In addition, textbooks also present information about jobs or careers that can encourage students to be enthusiastic about achieving their goals (Septia, M et al., 2021).

## 4. CONCLUSION

The four areas of science literacy—knowledge of science, the investigative character of science, science as a method of thinking, and interaction of science, technology, and society—are provided in the chemistry chapter book for grade XI SMA/MA on reaction rate material. However, it has not shown a balanced proportion between the four categories of science literacy. The percentage of occurrence of science literacy categories in chemistry chapter book grade XI SMA/MA on reaction rate material is science knowledge by 53.85%; investigation of the nature of science by 35.39%; science as a way of thinking by 9.23%; and interaction of science, technology, and society by 1.54%. The ratio between the four categories of science literacy is 35:23:6:1. So it can be concluded that the chemistry chapter book for class XI SMA / MA Merdeka curriculum on reaction rate material published by the Ministry of Education and Culture in 2022 has not represented the objectives of the Merdeka curriculum well.

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