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RESEARCH ARTICLE

Analisis Kebutuhan Modul Elektronik Laju Reaksi Dengan Pendekatan Socio-Scientific Issues Untuk Meningkatkan Literasi Sains Siswa

A Need Analysis Of Reaction Rate Electronic Module With Socio-Scientific Issues Approach To Improve Student Science Literacy

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ABSTRACT

The most important achievement in learning science is students' scientific literacy skills in processing and communicating phenomena in life into science concepts that have been studied at school. One approach that can foster scientific literacy skills is the approach to social issues in life in teaching materials in schools. This study aims (1) to analyze students' needs for teaching materials; (2) to analyze students' learning needs with the Socio Scientific Issues approach; and (3) to analyze students' scientific literacy preconceptual abilities. The method used is descriptive quantitative, using a clinical interview guideline instrument, with research subjects consisting of 10 students. This study used a purposive sampling technique. Data analysis involves several steps, namely data reduction, categorization, validity check, interpretation, and inference. The results of this study indicate that 1) There were 50% of students stated that they were bored with existing teaching materials, 54% stated that they preferred teaching materials that could be read as well as heard, 70% preferred modules, and 70% were very interested in social issues related to reaction rates, 2) Very few students can identify the context correctly and can explain correctly, 3) There were 45% of students did not know, 26% doubtful, and 29% students who know the application of scientific social issues. This shows that it is important to develop electronic chemistry modules based on socio-scientific issues to improve scientific literacy skills.

KEYWORDS

Electronic Module, Socio-Scientific Issues, Scientific Literacy, Reaction Rate

ABSTRAK

Pencapaian paling penting dalam pembelajaran sains adalah kemampuan literasi sains siswa dalam mengolah dan mengkomunikasikan fenomena dalam kehidupan ke dalam konsep sains yang telah dipelajari di sekolah. Salah satu pendekatan yang dapat menumbuhkan kemampuan literasi sains adalah pendekatan isu-isu sosial dalam kehidupan. Banyak isu-isu sosial yang terkait dengan konsep sains, namun belum sepenuhnya muncul dalam bahan ajar di sekolah. Penelitian ini bertujuan (1) menganalisis kebutuhan siswa terhadap bahan ajar; (2) menganalisis kebutuhan belajar siswa dengan pendekatan Socio Scientific Issues; dan (3) menganalisis kemampuan prekonsepsi literasi sains siswa. Metode yang digunakan adalah deskriptif kuantitatif, menggunakan instrumen pedoman wawancara klinis, dengan subjek penelitian terdiri dari 10 orang siswa. Penelitian ini menggunakan teknik purposive sampling. Analisis data melibatkan beberapa langkah, yaitu reduksi data, kategorisasi, pemeriksaan validitas, interpretasi, dan inferensi. Hasil penelitian ini menunjukkan bahwa 1) Sebanyak 50% siswa menyatakan bosan dengan bahan ajar yang ada, 54% menyatakan lebih menyukai bahan ajar yang bisa dibaca sekaligus didengar, 70% lebih menyukai modul, dan 70% sangat tertarik dengan masalah sosial yang berkaitan dengan reaksi. menilai, 2) Sangat sedikit siswa yang mampu mengidentifikasi konteks dengan benar dan mampu menjelaskan dengan benar, 3) Terdapat 45% siswa tidak tahu, 26% ragu-ragu, dan 29% siswa yang mengetahui penerapan isu-isu sosial ilmiah. Hal ini menunjukkan penting untuk dikembangkan modul kimia elektronik berbasis socio-sientific issues untuk meningkatkan kemampuan literasi sains.

KATA KUNCI

Laju Reaksi, Literasi Sains, Modul Elektronik, Socio-Scientific Issues

1. INTRODUCTION

The most important achievement in learning science is the ability of students to process and communicate information or phenomena that exist in life into science concepts that have been learned at school. According to Sumarni, [1] chemistry learning is learning that can form students who can apply the chemical concepts studied to phenomena encountered in life, not just memorizing concepts. The ability to communicate scientific concepts in life is called scientific literacy.

The scientific literacy ability of students in Indonesia is still far from what is expected. This can be seen from the results of the Program for International Student Assessment (PISA) international assessment which shows that Indonesia is still consistently in the bottom 10 [2]. This happens because the science learning process does not support students' scientific literacy skills [3]. One of the factors that cause the low level of scientific literacy of these students is that the existing teaching materials are not contextual [4].

One approach that can foster scientific literacy skills is to approach social issues in life, or socio-scientific issues. The socio-scientific issue is a problem about social issues related to science that requires moral and ethical reasoning in making decisions about the possibility of solving these issues. Many social issues are related to the concept of science but have not fully emerged in teaching materials in schools. According to Presley, Sickel, Muslu, & Merle[5] that socio-scientific issues are related to building students' scientific literacy skills. Rohmawati, Widodo, & Agustini[6] revealed that socio-scientific issues will help students to reason and think about a context. In addition, socio-scientific issues also train students to use information in a framework that fits both personally and in groups. Therefore, a socio-scientific issues approach is needed to change students' scientific literacy abilities. The application of the context of socio-scientific issues can be done in module teaching materials [7].

A teaching module is one of the teaching materials that can help students learn independently. Good learning modules are developed in various, innovative, and practical ways[8]. Along with the development of technology, a module is now developing in an electronic form which is commonly referred to as an e-module. The electronic module is a module that has the advantages of a printed module, such as its interactive nature, and can access images, audio, video, and animation at the same time. There is no difference in the principle of development for electronic and printed modules. The difference between the two is in the format of presenting the module physically [9].

Based on the interviews with chemistry teachers at a high school in Tanjungpinang, it was found that most of the teachers had never developed an electronic chemistry module. The teaching materials used are textbooks that have been facilitated by the school. The teachers had applied the use of context in learning, but not optimally. This is due to limited insight, and also limited sources of information. According to the teachers, students need the help of teaching materials that can integrate context in understanding the factors that affect the rate of reaction. Because this learning is often stuck with the process of memorizing cause and effect, without any application of context in it.

According to Marsuki, Amrilizia & Habiddin[10] in supporting more ideal learning, learning media is needed in the form of contextually based e-modules. This aims to increase students' thinking skills in understanding concepts and being able to relate scientific concepts in everyday life. Furthermore, according to Nastiti, Rahardjo & Perdana[11], students need module teaching materials to improve their generic science skills, so that learning becomes interactive, and interesting, and can motivate students. There has been much research on module development [7][9][12], but not many have developed electronic modules based on socio-scientific issues in chemical material, especially the reaction rate topic. So it is necessary to develop modules as media in carrying out learning.

This study aims to (1) analyze students' needs for electronic chemistry modules; (2) analyze students' learning needs with the Socio-Scientific Issues approach; and (3) analyze students' scientific literacy preconception skills.

2. METHOD

The method used is descriptive quantitative, using a clinical interview guide instrument. Clinical interviews are a process of interpersonal communication between researchers and informants in terms of the need for teaching materials for students. This aims to recognize, explore, to understand the conditions and needs of students precisely and accurately in learning. The interview guide instrument consists of 3 aspects adopted from Yulita [13] and 1 aspect from Niebert and Gropengiesser [14] that is content, context, the relation of content context, and student attitudes and interests. This interview guide was validated by 3 experts and produced a valid category (Appendix) using the Content Validity Ratio (CVR)[15] test. The content that is extracted is basic competency 3.4 in the 2013 curriculum, namely "Explaining the factors that affect the rate of reaction using collision theory."

The sources to be interviewed are 10 grade XII high school students who had studied the Reaction Rate material. This number was considered to represent the population because it was taken by purposive sampling consisting of 3 high ability students, 4 medium-ability students, and 3 low ability students[13]. This technique is a data collection technique with certain considerations . So, the results of the interviews will be reduced to 3 aspects of scientific literacy[2], namely aspects of content, aspects of context, and aspects of competence. Data analysis involves several steps, namely data reduction, categorization, validity checking, interpretation, and inference.

Table 1. Classification of students' content mastery of the material Reaction Rate.

Chemical Material	Revised Bloom's Taxonomy					
	C1	C2	C3	C4	C5	C6
	Remember	Under-stand	Apply	Analyze	Evaluate	Create
1. Definition of reaction rate		70% C 30% NC	50% C 50% NC	30% C 70% NC		
2. Factors affecting the rate of reaction	80% C 20% NC	50% C 50% NC	20% C 80% NC	20% C 80% NC		
3. Collision Theory	60% C 40% NC	50% C 50% NC	20% C 80% NC			
4. The relationship between collision theory and reaction rate factors	30% C 70% NC	20% C 80% NC	10% C 90% NC			

= 100% students are able; = 100% students are not able; C = Capable; NC = Not Capable

Determine the results of the percentage of interview results[16], namely

$$P = f/n \times 100$$

P = Percentage
f = Number answered
n = Number of respondents

3. RESULT AND DISCUSSION

Chemistry learning is science learning that is very close to life. The concept of chemistry is almost applicable and related to every activity of life. Starting from waking up to sleeping again, both natural phenomena and social issues. However, most students do not realize the connection between the social issues encountered and the chemistry concepts learned in school.

Respondents were asked according to aspects of the interview guide using the What, Why, and How questions. The following are the results of interviews related to students' scientific literacy skills on the reaction rate material:

3.1. Content Aspect

According to OECD[2], the content aspect is knowledge about scientific content. In this case, the researcher's knowledge is limited to the content of the reaction rate. The results of the interview, it was classified according to the level of Bloom's revised cognitive taxonomy[14] regarding students' knowledge of the material they had previously studied. The level of student content mastery on the reaction rate material is classified in Table 1.

This classification was obtained by the researcher from the analysis of interview data which began by writing down the transcript of the interview according to what the informant said. Then the researcher reduced the data through deductive coding, namely by looking at similarities or similarities across all categories or sources of answers in the transcripts.

From the classification that has been done, it can be seen that the student's ability to remember the terminology of a chemical concept, namely the notion of reaction rate, is developing well. All students can correctly state the meaning of reaction rate. However, this is not the case with the ability to evaluate and create. Furthermore, there are already several students who can analyze the concept of reaction rate and the factors that affect the reaction rate. However, students have not been able to analyze the concept of collision theory and the relationship between collision theory and reaction rate factors. There are interesting statements obtained from students during interviews, some students stated,

"I used to know, but now I forget"
(Students RH, SN, AP, RF, SL)

"I used to have high marks for this material, but now I have to read it again to remember it"
(Students AN, PL, AS)

The students' answers indicate that the learning that has been done does not give a deep impression to students. This is because the chemistry material taught is rigid, more on memorizing concepts. In addition, there is also a lack of stimulus given when the material is taught. As Mubarak et al [4] state that it is important to make learning meaningful. Students will be able to remember longer if given a memorable stimulus, such as by applying chemical concepts to social issues around them.

Table 2. Classification of students' abilities in the context of the reaction rate material context.

Question Type	Naïve(0)	Eclectic (1)	Informed (2)
Application of the concept of reaction rate material in life according to what has been studied	0	8	2
Other application examples	5	3	2
State the reasons for the application	10	0	0
Score	15	11	4
Percentage	**50%**	**37%**	**13%**

3.2. Context Aspect

According to Yulita (13), the context aspect is a situation in everyday life that is introduced to students by involving the concept of science in it. In this study, 2 types of questions were asked to students, namely regarding the application of the concept of the reaction rate material in life, mentioning other examples of application, and mentioning the reasons for the chosen application. And the results of the interviews have been classified into 3 to be naive, eclectic, and informed[16,17]. Where the naive category is considered unable to explain correctly, the eclectic category if the answer is correct but unable to explain, and the informed category if it explains the correct and precise concept. The categories are given the following points, namely: nave (N) = 0, eclectic (E) = 1, and informed (F) = 2. Furthermore, the number of respondents' answers will be presented by comparing the number of answers in the same category with the total number of answer items (X = 10). The classification of students' abilities in the context of the reaction rate is presented in Table 2.

From Table 2, it can be seen that there are still many students who are still wrong in applying the context aspect to the concept of reaction rate that has been studied. Only 2 students were able to answer about the application of the concept of reaction rate material with almost similar answers, namely the application of the rate of the combustion reaction and the rate of rusting reaction. At the time of the interview, the students mentioned the reason that the context was given during the first study and was listed in the school textbook. This shows that the provision of context in learning will strengthen the stimulus that will be stored in students' long-term memory. As Artuso & Palladino[18] stated that the effect of long-term memory will provide strength in the development of cognition.

However, it is unfortunate that the application of this context has not become the focus of learning so not all students are aware of the application of reaction rate content in everyday life. And learning becomes less meaningful. Whereas expected learning is learning that gives meaning to students [4].

3.3. Competency Aspect

According to OECD[2], competence is the ability to explain phenomena scientifically, evaluate and design scientific investigations, and interpret data and evidence scientifically. To analyze this ability, clinical interviews were conducted by digging up information about students' ability to relate the material to the context. There are 2 categories of questions, namely first asking students to name examples of social issues found in everyday life which are the application of the concept of reaction rate material, and secondly asking students to identify several phenomena that enter into the integration of social issues related to reaction rates.

Table 3. Classification of Students' Ability in Aspects of Competence in Identifying Social Issues Related to the Rate of Reaction.

Choice of Social Issues related to Rate of Reaction	Know	Doubt	Don't Know
a. Paper burning reaction	10	-	-
b. Rusting	10	-	-
c. Urine test	-	4	6
d. Advertisement of vitamin C tablets and vitamin C powder	3	7	-
e. Health advice on chewing	-	7	3
f. Food lasts longer in the fridge	-	2	8
g. Advice on how to take good medicine	-	1	9
h. Tenderize the meat using pineapple or young papaya	-	-	10
Average	**28,8%**	**26,2%**	**45%**

For the category of student answers in mentioning examples of social issues which are the application of the material concept of reaction rate, only 20% of students can mention it, while 80% are unable to mention it. Meanwhile, the results of student answers to identify several social issues related to reaction rates are classified into Know, Doubt, and Don't Know, which are presented in Table 3.

From the data obtained in Table 3, it can be seen that many students do not know the application of the context to the concept of reaction rate. Whereas all related contexts can be analyzed using the concept of reaction rate. For the context of the combustion reaction and rusting, almost all students are familiar with being an example of a reaction rate. As for the context of tenderizing meat using pineapple or young papaya, it is not very familiar as part of the factors that affect the reaction rate. Then, if the knowledge and doubt groups are added up, and compared to the ignorant group, the number of those who do not know is less. This means that students can guess the relationship of the context in the environment to chemical content, but have not been able to explain the relationship.

From the results of the interview, it can be seen that there is a barrier between the science material learned at school and social issues that exist in everyday life. The chemistry material studied at school should be able to explain phenomena that exist in life, at least it can explain thoroughly. This is the problem in science learning, where learning is more about learning theory but is not associated with problems in everyday life [19]. This is in line with [20] which states that contextual learning can build students' awareness of the importance of science, to form literate students.

From the results of the research data, a solution to the problems faced by students regarding scientific literacy skills is needed, one of which is by integrating scientific social issues into chemistry learning, so that there is an improvement in students' understanding of aspects of content, context, and competence.

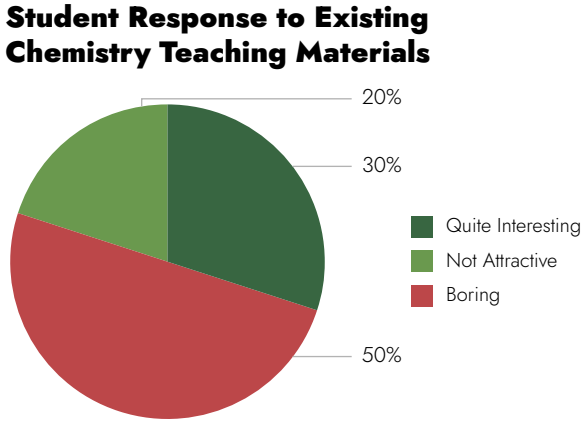

Figure 1. Responses to existing teaching materials.

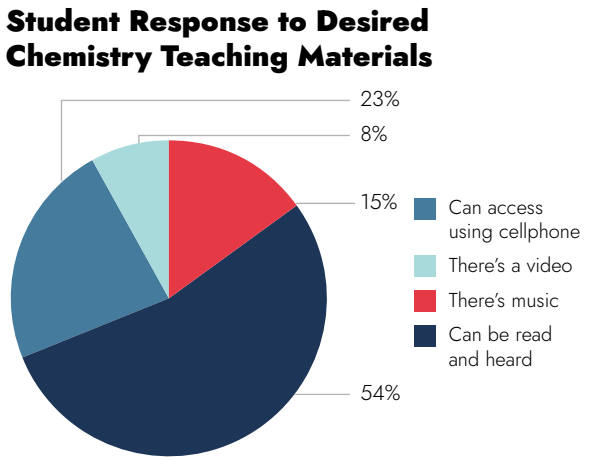

Figure 2. Student responses to the expectations of the desired chemistry teaching materials.

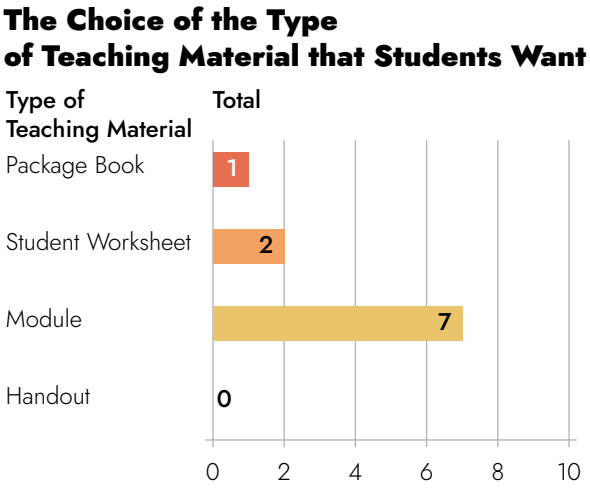

Figure 3. Types of teaching materials that students want.

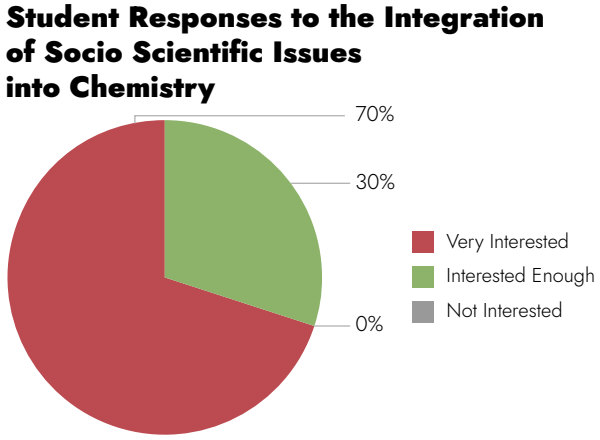

Figure 4. Student Responses to the Integration of Socio Scientific Issues in Chemistry Teaching Materials.

3.4. The Need for Innovation in the Development of Electronic Chemistry Modules

In the research, there is a question section that specifically asks about chemistry teaching materials. The questions consist of students' responses to

existing chemistry teaching materials, students' responses to the desired chemistry teaching materials, the choice of the type of chemistry teaching materials that students want, and students' responses to the application of socio-scientific issues into the chemistry teaching materials. The results of the responses related to this are presented in Figure 1, Figure 2, Figure 3, and Figure 4.

From Figure 1, it is known that in general students feel bored with the existing teaching materials, some even state that they are not interesting. In addition, no one said it was interesting, only 30% said it was quite interesting. This shows the student's need for the renewal of teaching materials. So teachers should innovate in the development of teaching materials. This is in line with the opinion of Nazilah, Muharrami, Rosidi, & Wulandari[21] and Rostikawati & Permanasari[22] which state that teachers must innovate in developing teaching materials. As done by Asikin & Yulita[23] who developed the design of teaching materials based on scientific literacy.

Furthermore, in Figure 2 from the interviews, it was found that students wanted teaching materials that could be accessed via cellphones, and had videos, sounds, and teaching materials that besides being readable could also be heard. This shows that the teaching materials expected by students are electronic. While regarding the 4 choices of teaching materials given to students, textbooks, LKPD, Modules, and Handouts, it turns out that 70% of students choose modules. Students stated that the module was preferred because it presented more complete and detailed material, making it easier for them to learn. This is in line with the opinion [8] which states that a module is a form of teaching material that is packaged completely and systematically, this will make it easier for students to learn because of the completeness of the material. Modules contain planned learning experiences and are designed to help students achieve detailed learning objectives.

Then, in Figure 4, students are asked about their attitudes when scientific social issues are to be included in teaching materials. Students were given the choice of very interested, moderately interested, and not interested, and it turned out that 70% of students were very interested, 30% of students were quite interested, and there were no students who were not interested. This shows that students have an interest in implementing scientific social issues into teaching materials.

3.5. Students have not been able to develop social issues in everyday life related to chemical content

At the time of the interview, there were questions aimed at seeing students' abilities in integrating scientific social issues into teaching materials. It was found that students have not been able to identify the context related to the reaction rate material. This can be seen in Figure 5

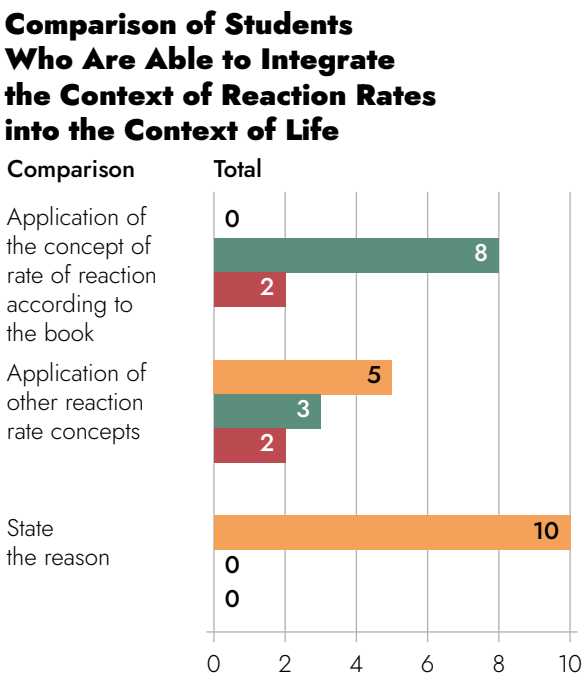

Figure 5. Comparison of students who are able to integrate the content of reaction rates into the context of life.

From Figure 5, it can be seen that for the application of context to the reaction rate material according to the book, there are still many students who fall into the naive and eclectic categories. There are still very few students who fall into the informed category. This shows that students are not able to explain correctly, and even if they can answer correctly, they are not able to explain correctly. Very few students can identify the context correctly and can explain it correctly.

This happens because there is still a lack of application of the context in the textbook. At the time of the interview, it was seen that students were able to mention the application of the appropriate context in the book. But unfortunately, the context

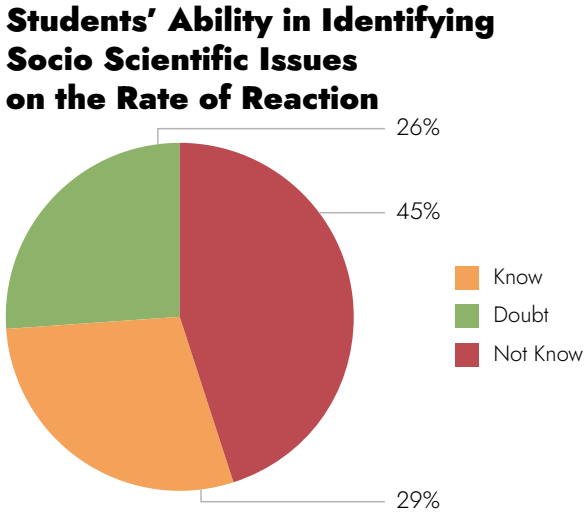

Figure 6. Students' Ability in Identifying Socio Scientific Issues on the reaction rate.

is very minimal, and students are not able to develop in other contexts. That is, the examples in the book are less stimulating for students to be able to develop their literacy skills. This is in line with Gustita'iroha, Rohmahb, & Faiq[24] who state that learning related to socio-scientific issues can improve student scientific literacy.

3.6. Students are only able to guess the relationship of science concepts with the given context, without being able to analyze them well.

At the time of the interview, several social issues were given, which are familiar to their daily environment, but students have not been able to analyze them well. Students just can guess the relationship, without knowing the cause and effect or without applying the chemical concepts they have learned.

From the results of the interview, it can be seen that 45% of students answered they did not know, while 26% answered doubtfully. While students who know the application of scientific social issues are only 29%. This indicates that students have not been able to analyze the context of chemical content. During interviews, many students answered with the words "Maybe like this... Maybe like that... I don't understand... Really...". This shows that students are still not brave and have not been able to make decisions about existing phenomena. Thus, as Rahayu[25] states that students who have poor literacy skills will not be able to solve problems in complex situations.

Thus, it is important to improve students' scientific literacy skills so that students are scientifically literate by integrating scientific social issues into teaching materials. The results of the Lawe & Dopo[26] research state that teaching materials made by teachers must pay attention to the social environment of students. Teachers should be able to integrate the student's environment or student social life into teaching materials by using concrete examples of the student's social environment.

Overall, based on the results of the analysis, students need an electronic chemistry learning module based on socio-scientific issues to improve their scientific literacy skills. The process of developing electronic teaching materials with a socio-scientific issues approach has been shown to have a major influence on the role of students in building students scientific literacy[27].

4.CONCLUSION

The results of this study indicate that the level of student content mastery on the reaction rate material is just to analyze classified, many students are still wrong in applying the context aspect to the concept of reaction rate that has been studied and do not know the application of the context to the concept of reaction rate. As many as 50% of students stated that they were bored with existing teaching materials, 54% stated that they preferred teaching materials that could be read as well as heard, 70% preferred modules, and 70% were very interested in social issues related to reaction rates. Students have not been able to develop social issues in everyday life related to chemical content. Students are only able to guess the relationship of science concepts with the given context, without being able to analyze them well. So, students need innovation in developing reaction rate electronics modules and integrating socio-scientific issues

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