IJCE, Vol. 1, No. 1, July 2024, pp. 14 – 20

Indonesian Journal of Chemical Education

https://journal.uny.ac.id/index.php/ijce/index

Analysis Of Ethnoscience Integrated Chemistry E-Modules On Reaction Rate Material To Strengthen Chemical Literacy Of High School Students

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Article Info

Received: Jul 25th, 2024
Revised: Oct 12th, 2024
Accepted: Nov 1st, 2024

Keywords:

chemical literacy, electronics, e-modules, ethnoscience

Abstract

The fading national identity has led to the need for ethnoscience-based learning. Chemistry is one of the subjects in high school. One of the materials that is considered difficult for students is the reaction rate. The same learning media makes learning uninteresting and boring. This study aims to explore the needs of teachers and students for the development of teaching materials in the form of e-modules integrated with ethnoscience on the reaction rate material which is expected to strengthen students' chemical literacy. This research method is an exploratory survey. Data were obtained through interviews with teachers and semi-open questionnaires with students. The study was conducted on 5 teachers and 15 students from three different high schools in Yogyakarta City. The results of the analysis of grade XI students showed that 93.3% of students needed an ethnoscience-integrated chemistry module because it helped understanding, getting to know ethnoscience, was interesting, not boring, and made it easier, while teachers hoped that the reaction rate module developed was related to everyday life and interactive.

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e-ISSN 2581-2645

INTRODUCTION

Indonesia has a very high level of cultural diversity (Pitoyo et al., 2017). The process of globalization and cross-cultural interaction in Indonesia has had an impact on the fading of cultural identity and community character. Loss of cultural identity affects the development of the nation's character, especially the younger generation. Problems that arise in society, such as cases of moral and immoral crimes, are considered the impact of the loss of cultural identity of the younger generation in Indonesia. Education as one of the means considered to be one of the solutions to solving problems faces challenges to create solutions and innovations in its role, both through formal, non-formal and informal education processes. Learning with an ethnoscience approach is learning that links local culture, indigenous knowledge and scientific knowledge has been developed in various countries (Sudarmin et al., 2017). Ethnoscience is a cross-disciplinary knowledge that is a collaboration between various subject areas, be it science, social, or mathematics. At the same time, ethnoscience is increasingly transdisciplinary (Laar et al., 2017). Therefore, ethnoscience can be integrated in science learning, one of which is in chemistry.

Chemistry is the study of matter including its composition, properties and changes, as well as changes in energy that accompany these material changes. The study of chemistry is considered one of the difficult fields at the high school level. Chemistry learning should be related to the cultural background of students, so that it is relevant to their lives, so that meaningful learning will be obtained. Ethnoscience relates to knowledge derived from culture that can serve as the basis for building a reality that emphasizes cultural relationships with the latest scientific knowledge. Ethnoscience integrated as content in teaching materials can be designed so that learning is not only oriented to cognitive aspects but equips students to be able to solve problems in real life using chemical

understanding (Sumarni, 2018). Science learning, including chemistry learning, will be more easily understood by students if teachers pay attention to their culture. With this cultural integration, students will easily understand the material and improve their literacy skills.

The Programme for International Student Assessment (PISA) is a three-year survey conducted by the Organisation for Economic Co-operation and Development (OECD) of 15- year-old learners that assesses key knowledge and skills essential for full participation in society. Since 2000, Indonesian students have taken the PISA test seven times and remained in the low category (Avvisati et al., 2019). The results of the last test in 2022, showed that Indonesia's science or chemistry literacy rank rose 6 positions compared to before. This shows that Indonesia has hope to be able to rise to a higher rank. Chemical literacy can be applied in learning through an ethnoscience approach to material that is considered difficult by students and requires visualization.

The reaction rate is one of the chemistry materials that is considered difficult, this is based on data on the percentage of students' daily test completeness for the last three years, obtained results that are more than 50% of students are not complete. The incompleteness experienced is because the reaction rate material is abstract in nature, causing misconceptions in students. (Nurmartarina, 2021). Students must need conceptual understanding and algorithmic operation skills in understanding reaction rate concepts. Misconceptions in reaction rate material are also found in the low performance of students in calculating reaction rate material. With the help of media, it will be very helpful for the thinking process of students to understand the material correctly. The use of media in the learning process is one of the efforts to create better quality learning.

E-modules are part of electronic based e-learning whose learning utilizes electronic devices as a medium in communicating and conveying information (Nadhifah et al., 2017). Many chemistry e-modules have been developed with varied materials, but e-modules with an ethnoscience approach are rarely found. The use of e-modules is able to attract the attention of students to learn and the learning process will be more enjoyable than using printed modules. Teaching materials in the form of electronic modules have several advantages, including making it easier for students to get information using electronic devices owned by these students, whether in the form of PC computers, laptops, iPads, or cell phones (Nurhayati et al., 2021).

Based on research conducted by Andayani, et al (2021) from 113 chemistry teacher respondents in West Nusa Tenggara province, 69.03% have never read and found media in the form of modules that use an ethnoscience approach in learning. In general, the study stated that it is important to include culture in chemistry learning. In addition, currently humans cannot be separated from technology. Digital technology and the internet have dominated all elements of society and all areas of life, including education. Technology is at hand, not just a slogan. Humans can use technology for the desired things, both in positive and negative terms depending on the mindset of its users.

The initial needs analysis aimed at teachers and students is carried out so that the products developed can be in accordance with what is needed in the learning process at school. Thus, the developed product can be used in accordance with learning needs. The purpose of this research is to explore the needs of ethnoscience integrated e-modules on reaction rate material to strengthen the chemical literacy of high school students.

METHOD

This study was conducted with the aim of exploring the need for ethnoscience integrated e- modules on reaction rate material to strengthen the chemical literacy of high school students. Research methods including research type and design, participants and research context, data collection techniques and instruments, and data analysis are briefly described in this section.

Type and Design of the Research

This research method is an exploratory survey with a qualitative approach. The focus of this research is to explore the need for ethnoscience integrated e-modules on reaction rate material to strengthen the chemical literacy of high school students. This research describes ethnoscience, the relationship between ethnoscience and chemistry learning, the integration of ethnoscience in chemistry learning materials, and its effect on the chemical literacy of high school students.

Participants and Context of the Research

This study included 5 chemistry teachers and 15 high school students in three different schools in Yogyakarta City, so that approximately 2 chemistry teachers and 5 students were selected for each high school. The students have or will learn reaction rate material at their grade level. Chemistry teachers were also selected based on the chemistry teacher who taught the reaction rate material at the relevant grade level. The participants were selected based on the convenience of the researcher.

Data Collection Technique and Instrument

Data were obtained through interviews with chemistry teachers and half-open questionnaires to high school students with question items adapted from Jarqi (2019). The interview was conducted by asking questions consisting of 16 questions covering reaction rate material, teaching materials used, chemical literacy, and ethnoscience. While the half-open questionnaire uses the help of g-form for data collection with 15 questions with almost the same coverage as the teacher interview items. Before conducting interviews and distributing questionnaire sheets, validation was carried out with a supervisor related to the question items.

Data Analysis

Qualitative data was obtained from the results of the needs analysis with instruments in the form of interview sheets and half-open questionnaires. The data analysis technique was carried out by recapitulating the responses to the results of filling in the data obtained. The results of the data recap were used to perform the coding step. There are two stages in this coding step, namely initial coding and axial coding. Initial coding is done by giving meaning in the form of vocabulary or labels according to existing data. Meanwhile, axial coding is done by creating themes or categories. Furthermore, the creation of concepts or theoretical ideas related to the codes and themes generated.

FINDINGS AND DISCUSSION

Findings

In the analysis of the needs of this e-module, it is divided into 2, namely the analysis of the needs of teachers and the analysis of the needs of students, which will be described below as follows:

Teacher Needs Analysis

In the analysis of teacher needs, the first thing to do is to design an interview sheet containing questions which are adaptations of Jarqi (2019) regarding the difficulty of teaching reaction rate material, reaction rates associated with everyday life, teaching materials used, the level of students' chemical literacy skills, ethnoscience and its application in chemistry learning. This teacher needs data analysis obtained answers from interviews with 5 chemistry teachers from 3 different schools in Yogyakarta City.

Based on the interviews that have been conducted to chemistry teachers in Yogyakarta City, the following results are concluded:

Table 1. Teacher needs analysis interview results

Aspect	Interview questions	Interview answer
Implementation of the Independent Curriculum	What's new about implementing the Merdeka curriculum?	The new thing when implementing the Merdeka curriculum is the material and the existence of P5.
rate material challenge	What are the difficulties when implementing learning reaction rate material?	Difficulties in implementing chemistry learning on reaction rate material exist in calculations (equations) and practicum implementation (relationship with theory and material difficulties).

Aspect	Interview questions	Interview answer
	How do you relate reaction rate material to everyday life?	Reaction rate material can be related to everyday life such as consumable objects (food and drinks), reactions around life, and transportation.
Students' chemical literacy level	What is the level of chemical literacy skills of students in class XI?	The level of students' chemical literacy skills is still lacking and needs a trigger from the teacher.
	How is the availability of teaching materials that support students' chemical literacy?	The availability of teaching materials at school is sufficient to support chemical literacy but some are insufficient and have to look for other references
Integration of ethnoscience	Can reaction rate learning be integrated with ethnoscience, What are some examples?	Learning reaction rates can be integrated with ethnoscience, it's just that I haven't been able to find an example.
Media development expectations	What kind of teaching materials or modules do you expect for Reaction Rate material, so that students can easily understand the material?	Teaching materials or modules that are interesting, related to everyday life, interactive, and many examples of clear problems and formulas are expected for the reaction rate module so that students easily understand the material.

Before obtaining the conclusion of the answer, *initial coding* and *axial coding* were carried out, then the frequency and percentage of answers were obtained as follows:

Table 2: Coding results of teacher needs analysis

Question	Answer	Frequency	Percentage (%)
At this time, does your school use the Merdeka Curriculum?	Already	5	100
What new things did you experience when implementing the Merdeka Curriculum?	P5	3	60
What are your difficulties in implementing Chemistry learning material Reaction Rate?	Calculation (equation)	3	60
How do you relate the reaction rate material to everyday life?	Consumer goods	2	40
How do students respond when learning Reaction Rate is related to everyday life?	Interested	3	60
Do you prepare teaching materials for learning Chemistry in the classroom? In what form (printed or electronic) are the teaching materials?	Electronic	4	80

Question	Answer	Frequency	Percentage (%)
Have you ever used *e-modules* in learning Chemistry? If so, what are the contents of the modules used?	Ever, content in general	3	60
According to you, what is the level of chemical literacy skills of students in class XI?	Less	2	40
How is the availability of teaching materials in your school? Is it sufficient to support students' chemical literacy?	Simply	3	60
Are there any reading materials (e.g. enrichment books or scientific magazines) that can support Chemistry learning at school?	Available, limited	3	60
Have you ever heard the term "ethnoscience"?. If so, have you ever integrated it in Chemistry learning in the classroom?	Have heard of and integrated	3	60
Do you think Reaction Rate learning can be integrated with ethnoscience? If so, what are some examples?	Can, haven't found an example yet	5	100
Have you ever come across teaching materials about ethnoscience related to learning Chemistry, especially Reaction Rate material?	Never been	5	100
According to your observations, do students currently prefer printed or electronic teaching materials? What is the reason for this?	Electronics, ease of use	4	80
What kind of teaching materials or modules do you expect for Reaction Rate material, so that students can easily understand the material?	Associated with daily life	2	40
Do you think the electronic-based module can help students understand chemistry, especially reaction rate material?	Can	5	100

Student needs analysis

In the analysis of student needs, the first thing to do is to compile questions into a questionnaire sheet, validated, and given to students to be able to analyze student needs regarding the learning process related to the teaching materials used. The results of the question analysis are as follows.

Table 3. Analysis of student needs analysis answers

Answer Analysis	Percentage (100%)
Students understand the relationship between reaction rates with examples in everyday life.	80
Students like teaching materials with video and photo visualization	24
Students like the use of interactive, informative, and interesting media that can help increase interest in chemical literacy.	40

Answer Analysis	Percentage (100%)
Students need an ethnoscience integrated chemistry module because it helps understanding, recognizes culture, is interesting, not boring, and makes it easy.	93,3
Students need an ethnoscience integrated reaction rate module because it helps understanding, recognizes ethnoscience, relates to life, and the material is more complete.	86,7

Discussion

This section is a discussion of the data that has been obtained. In the analysis of teacher needs interview questions in table 1. is the conclusion of the 16 questions given. It can be seen that teachers have difficulty teaching reaction rate material in the calculation (equation) and practicum sections. Teachers often associate reaction rate material with daily life and student responses are interested, enthusiastic and easy to understand the material. The level of chemical literacy of students in class XI is still minimal and needs to be sparked by the teacher, teaching materials at school are also less supportive to improve students' chemical literacy. Teachers are not accustomed to integrating ethnoscience in learning so they have not been able to find examples of ethnoscience integration in reaction rate material. Teachers hope that the reaction rate module to be developed is related to daily life and interactive.

According to the coding results in table 2. the average teacher has integrated examples of daily life in the reaction rate material, but not for ethnoscience, even 40% of teachers have never heard the term ethnoscience. All teachers have never encountered chemistry teaching materials for reaction rate materials integrated with ethnoscience. Teachers also explained that the abstract reaction rate material could be related to ethnoscience. In this digitalization era, media with electronic assistance according to the teachers will make it easier for students to learn. The use of e-modules in learning makes it easier for students to understand scientific concepts, thus having an impact on pleasant and interesting learning conditions (Retno et al., 2021). Research conducted by Rahmawati, Ridwan, & Nurbaity in 2017 which examines ethnoscience in the field of chemistry or can be referred to as ethnochemistry shows that ethnoscience is able to bring out chemical literacy skills so that the use of Batik Pekalongan as a form of ethnoscience can be used in assessment instruments to measure students' chemical literacy skills. The teacher hopes that there will be an electronic-based module development that can facilitate students in reaction rate material by integrating ethnoscience.

Furthermore, the analysis of student needs can be seen based on table 3. that 80% of students understand the relationship between reaction rates and daily life, this is because teachers often provide examples around students' lives. According to students, chemistry material is difficult to learn so teaching materials with video and photo visualization are needed so that it is not boring and easy to understand. 40% of students like the use of interactive, informative, and interesting media that can help increase interest in chemical literacy, this is because the level of chemical literacy of students is still minimal. In addition to being given examples in everyday life, students also need knowledge about the relationship between local culture and scientific knowledge, especially in chemistry learning. 93.3% of students need an integrated chemistry module ethnoscience because it helps understanding, recognizes ethnoscience, is interesting, not boring, and makes it easy. According to 86.7% of students, the module can help understanding, recognize ethnoscience, relate to life, and the material is more complete. The solution that can be given to overcome the problem based on the results of the analysis above is to develop teaching materials to be able to improve students' understanding of chemistry material, especially reaction rate material. In the development of chemistry teaching materials, it must be integrated into a model/method/learning approach in order to make the teaching materials more systematic. Ethnoscience is a learning approach that connects local culture with scientific knowledge. According to Yuliana (2017), by studying the peculiarities found in a community, students can understand the natural events around them and can relate them to the field studied by the student.

CONCLUSION

Based on the research conducted, it is known that high school students in Yogyakarta City really need a new teaching material with technological applications in the form of electronic modules that are able to increase

interest in chemical literacy. Ethnoscience integration is also needed so that students can easily understand complex chemical materials and be culturally literate. The right teaching material to use is to develop teaching materials in the form of ethnoscience integrated chemistry E-modules on reaction rate material as a strengthening of chemical literacy of high school students.

REFERENCES

Nadhifah, N., & Muslih, I. (2017). Capacity Building of Teachers in Developing Information and Communication Technology (ICT) Learning Media at Madrasah Ibtidaiyah Thoriqul Huda Randuharjo Pungging Mojokerto. *Modeling: Journal of PGMI Study Program*, 4(2), 172-191.

Nurhayati, E., Andayani, Y., & Hakim, A. (2021). Development of STEM-based Chemistry E- Modules with an Ethnoscience Approach. *Chemistry Education Practice*, *4*(2), 106-112. https://doi.org/10.29303/cep.v4i2.2768.

Nurmartarina, D., & Novita, D. (2021). Cognitive Conflict Strategy as Remedial Learning for Reaction Rate Materials to Reduce Misconceptions of Students in Class XI MIPA SMAN 2 Blitar. *PENDIPA Journal of Science Education*, 5(3), 328-336.

Pitoyo, A. J., & Triwahyudi, H. (2017). The dynamics of ethnic development in Indonesia in the context of state unity. *Population*, 25(1), 64-81.

Rahmawati. Y, Ridwan. A, Nurbaity. (2017). Should we learn culture in chemistry classroom? Integration of ethnochemistry in culturally responsive teaching. *AIP Conference Proceedings*, 1868, 030009.

Sudarmin, Febu. R, Nuswowati. M, Sumarni. W. (2017). Development of Ethnoscience Approach in The Module Theme Substance Additives to Improve the Cognitive Learning Outcome and Student's entrepreneurship. . *Phys: Conf. Ser.* 824

Sumarni, W. (2018). The influence of ethnoscience-based learning on chemistry to the chemistry literacy rate of the prospective teachers. *Unnes Science Education Journal*, 7(2).