
CHEMISTRY E-MODULE BASED ON SOCIO SCIENTIFIC ISSUES (SSI) FOR REACTION RATE MATERIAL TO INCREASE SENIOR HIGH SCHOOL STUDENTS' CHEMICAL LITERACY

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ABSTRACT

Learning chemistry contributes to chemical literacy in specific and science literacy in general. Chemical literacy relates to the ability to think scientifically by using chemical knowledge and natural phenomena identification. Chemical literacy is defined as the ability to understand and implement chemistry knowledge in everyday life by comprehending three aspects comprising: knowledge, awareness and chemistry implementation in everyday life accurately and effectively. Based on the result of the questionnaire which has been distributed to chemistry teachers in Jember regency through chemistry MGMP, it shows that 71,8% of chemistry teachers stated that students' chemical literacy skill in learning did not meet the target. Chemical literacy has significant relation to the Socio-Scientific Issues (SSI) drawn as social problem by using scientific context. This problem considered as scientific issue developed in society. Then, this problem is analyzed further in rate reaction materials. This research used quasi-pretest-posttest experiment without using control class. To analyze the data, this research used both quantitative and qualitative methodologies. The sample in this research consisted of 36 senior high school students in Senior High School of Ambulu grade XI MIPA 6. The result of this research based on both pretest and posttest using open ended questions showed that there was significant improvement on students' chemical literacy. Therefore, it was in high category

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INTRODUCTION

Science literacy is defined as one of sixteen skills that is needed in learning process in 21 century (Rahayu, 2017). Science literacy is wide concept. In this case, teaching any specific subject in science education must contribute to train people in science literacy (Celik, 2014). This concept brings up theoretical definition such as biological literacy and chemical literacy as part of science substance.

(Thummathong & Thathong, 2018) defined chemical literacy as someone's ability to understand and implement chemistry knowledge in everyday life by mastering three main concepts comprising: knowledge, awareness and chemistry implementation in everyday life effectively and accurately. People who contributed in chemical literacy should appreciate and able to use this knowledge in their daily life (Arbid, Samir, & Tairab, 2020). To be chemically literate, someone should has higher learning skill, for example the skill to produce useful questions and to look for information to answer those questions (Anggraini & Wahyuni, 2020).

The result of both teachers and students' questionnaire that have been distributed through MGMP chemistry community in Jember regency shows that students' chemical literacy skill in learning is not enough. According to (Arbid et al., 2020), he stated that the low chemical literacy was caused by some factors; monotonous learning methods and the use of learning model and strategy couldn't enhance students' chemical literacy. Socio-Scientific Issues (SSI) approach has correlation to science literacy (Tekin, Aslan, & Yilmaz, 2016) and (Topçu, Atabey, & Çiftçi, 2022). Socio-Scientific Issues (SSI) provides complicated and controversial problems so that it can be the source of society's main attention in the scope of scientific and principle views (Türköz & Öztürk, 2019). Socio-Scientific Issues (SSI) implementation in learning process allows students to develop scientific reasoning skill, critical thinking skill, moral and ethical reasoning, decision making skill, growing students understanding related to science substance and science literacy as the goal of science education (Arbid et al., 2020) (Forum, 2015) (Islamiyah, Rahayu, & Dasna, 2022).

The problem in Socio-Scientific Issues (SSI) is factual problem which consists of: global warming, nuclear energy, genetic manipulation, biotechnology and pollution. One of subjects in senior high school student is reaction rate material (Kurniati, 2017) (Kurniati, 2017). This section is used for grade XI that can be categorized into the ultimate section because it has significant correlation toward daily life. Moreover, it is important to learn reaction rate as basic applied science in industry, medical and environment. Because of this, SSI integration in E-module could train the students to explore themselves and to look for solution toward some problems that arise in society so that literacy skill developed.

RESEARCH METHOD

This research deals with one group experiment research; one group pretest and posttest designs. The sample in this research consists of 36 students of grade XI MIPA 6 in Senior High School of Ambulu. Students in one class are given reaction rate pretest to measure their understanding. After that, those students are taught by the teachers to learn reaction rate by using E-module based on SSI. Then, the students are given posttest to measure their ability after learning rate reaction using chemistry e-module based on SSI. Pretest and posttest instruments are in the form of relevant open-ended questions to SSI so that it could be used to measure students' chemical literacy. Those open-ended questions are based on three chemical literacy concepts; knowledge, competency and behavior. Those three chemical literacy concepts can be seen through table 1 as followed.

Table 1
Chemical Literacy Aspects

Chemical Literacy Aspects	Chemical Literacy Domain
Knowledge	Chemical content
	Procedural
	Epistemic
Competency	Explaining phenomenon scientifically
	Evaluating and designing scientific incubation
	Interpreting data and scientific evidence
Attitudes	Perception and awareness toward environmental issues

(Muntholib *et al*, 2020)

The data collection in this research uses test methodology. The obtained data were analyzed further qualitatively and quantitatively. The quantitative data are in the form of students' chemical literacy description. While the quantitative data are in the form of score improvement on students' chemical literacy skill. It could be seen through N-gain based on score criteria shown in table 2 below.

Table 2
The Result of Chemical Literacy Criteria

N-gain	Criteria of Effectiveness
$N\text{-gain} > 0,7$	High
$0,3 \leq N\text{-gain} \leq 0,7$	Medium
$N\text{-gain} < 0,3$	Low

(Hake, 1999)

RESULTS AND DISCUSSION

A. Chemistry E-Module Based on SSI

E-module based on SSI is designed by using the latest technology that carries social scientific issues in order to improve students' learning independency. This module gives clear understanding by presenting social scientific issues that develop in surrounding environment. It can be analyzed and

explored further by the students through problem solving process using minimal teachers' guidance (Prayogi & Yuanita, 2018). This process aims to make students' capability in analyzing and implementing certain concept. It happens because it gives significant impact on their chemical literacy skill. Chemical literacy skill requires students to be aware toward themselves and their environment to solve some problems existed in their surrounding environment using their chemical literacy skill (Putra, 2020).

To enhance students' chemical literacy, this module is published systematically by showing certain discourse in the form of social scientific issues derived from electronic media such as: accurate and reliable news and newspaper. The writing model of chemistry e-module is based on SSI that has been developed and modified by (Kurniati, 2017) (Putra, 2020). This module consists of three parts; introduction, discussion and conclusion. Introduction chapter involves acknowledgment, table of content, concept idea, main competency, basic competency, competence attainment indicator, a brief e-module description and module instruction. Discussion chapter comprises three sub chapters; tittle, research goals, discussion and learning activity based on SSI to enhance students, chemical literacy, summary and exercises. The conclusion chapter consists of competency test, answer key, glossary and bibliography.

B. Students' Chemical Literacy

Quantitative data of students' chemical literacy is gained from pretest and posttest scores. These pretest and posttest scores are in the form of open-ended questions reaction rate contextual questions. These questions deal with social scientific issues developed in society in order to measure three chemical literacy aspects; knowledge, competency and behavior. Pretest and posttest percentage are counted using N-gain as it is shown in table 3.

Table 3
Students' Chemical Literacy Score

Chemical Literacy Criteria	Chemical Literacy Percentage Score
High	61,11%
Medium	36,11%
Low	2,78%

According to the data above, it can be seen that students, chemical literacy pretest and posttest score using N-gain is in high score (61,11%), average score (36,11%) and the lowest score (2,78%). The average of N-gain is 0,71 which is categorized into high category. Because of this, the development of chemistry e-module based on SSI is effective to enhance students' chemical literacy. In case, chemical literacy is someone's ability to comprehend and implement chemistry in everyday life in the scope of understanding three essential concepts; knowledge, awareness and chemistry implementation in daily life effectively and accurately

(Thummathong & Thathong, 2018) (Putra, 2020). Chemistry literate people should appreciate and able to use chemistry in daily life.

Students' chemical literacy in this research is measured through learning process using chemistry module which is based on SSI. The result of the research above relates to the previous research because it is stated that learning by using SSI successfully enhance students' chemical literacy. In this case, SSI problems can be used as a tool to: (a) creating learning chemistry more applicable toward students' life, (b) directing learning results by appreciating NOS as science substance, (c) guiding dialogue argument, (d) enhancing the ability to evaluate scientific information, and the essential aspect in science literacy (Rahayu, 2017). Hence, SSI contributes to inspire, provoke and create controversy ideas toward scientists' questions which have no solution yet. Because of this reason, SSI has significant potency to train students' brain power to solve problem in real life. Using this module as learning material based on SSI also helps to improve students' chemical literacy. Module is learning sources that can be used by students independently due to the existence of instruction within the module itself (Nasional, 2008) (Sunyono & Efkar, 2020). Moreover, it is also necessary to use module which is based on the recent technology / SSI so that it can help learning process. Implementing e-module in learning process can assist students to be more active and learning center does not rely only on teachers. Therefore, this module is easy to use, understandable and interesting to use using SSI approach. Thus, e-module contributes to accessibility to use anywhere.

CONCLUSION

According to the result of this research, it can be concluded that students' chemical literacy skill is in high category (61,11%). In this condition, there is no students who are classified in to low category. Thus, chemistry e-module based on SSI is effective to enhance students' chemical literacy. The significant improvement of students' chemical literacy shows students' capability to analyze and implement certain concept toward the problem in society.

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