Effectiveness of Socio-Scientific Issue (SSI) Based Science E-Modules to Increase Students' Scientific Literacy

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Abstrak: An important component in the learning process is the existence of teaching materials for students. Teachers need a variety of teaching materials, both in the form of textbooks and modules that can help carry out the learning process well. This research aims to test the effectiveness of a Socio-Scientific Issue (SSI) based science e-module to increase students' scientific literacy. This type of research is quasi-experimental research with a One Group Pretest-Posttest Design. The research was conducted in three class VII MTs Nurul Iman Dasan Makam, Sukamulia District, East Lombok Regency. The effectiveness of the e-module is obtained by providing test questions at the beginning (pretest) and at the end (posttest) of learning to measure the increase in students' scientific literacy. The results of the analysis of the effectiveness of increasing scientific literacy are in the medium category with an average N-gain score of 0.47. The research results show that the implementation of the SSI-based science e-module is quite effective in increasing students' scientific literacy so that it can be used as a teaching material for science learning.

Kata Kunci: E-module; Natural sciences; SSI-based learning; Scientific literacy

Introduction

21st century skills in the independent curriculum are integrated with scientific literacy and strengthening the education profile of Pancasila students in the teaching and learning process (Rahayu et al, 2022). Scientific literacy skills provide opportunities to answer problems competitively, innovatively, creatively, collaboratively and with character (Hadsaputra et al, 2019). Some experts view that scientific literacy leads to functional literacy, namely literacy needed to carry out work and life functions (Rahayu et al, 2022; Hanson, 2022). PISA (Program for International Student Assessment) determines four aspects of assessment in scientific literacy, namely context, competence, knowledge and attitudes. The context in scientific literacy involves issues that are very important in everyday life both personally, locally or nationally, and globally (Brown & Lawless, 2019). Competency in scientific literacy is divided into three aspects, namely explaining phenomena scientifically, evaluating and

designing scientific inquiries, and interpreting data and evidence scientifically (OECD, 2017).

The low scientific literacy abilities of students can be proven from the PISA report in 2018 which states that the average science score of students in Indonesia ranks 64th out of 65 participating countries (Rahayu et al, 2022). Another factor that influences students' scientific literacy abilities is school facilities and infrastructure in the form of learning resources. An important component in the learning process is the existence of teaching materials for students (Komalasari et al, 2019). Various efforts have been made to provide science learning that sharpens and improves scientific literacy (Rudolph, 2024). The application of the problem-based learning model (PBM) has a better and more significant influence on students' scientific literacy (Marlina et al, 2021). The development of e-modules is one of the important efforts that must be carried out and is urgent because it is to anticipate and adapt to the era of digitalization which has a very significant impact in the field of education (Lestari, 2018). The advantage of e-modules

compared to printed modules is that they are interactive, making it easier to navigate, allowing to display or load images, audio, video and animation as well as formative tests or quizzes immediately (Prabu Kumar et al, 2022).

Research conducted by Hariani et al., (2020) resulted in the use of e-modules on salt hydrolysis material with the GIL learning model which can improve students' understanding of concepts. In line with that, Agung et al., (2020) stated that students who use e-modules find it easier to find material concepts compared to those who do not use e-modules, this is because e-modules are equipped with material, practice questions. which contains key questions to help students discover a concept independently so that learning outcomes also increase. Research conducted by Sari, et al (2018) regarding the use of GIL-based e-modules in Virlabs integrated colloid system material can improve student learning outcomes. Previous research only developed e-modules combined with learning models. This research focuses on developing an effective Socio-Scientific Issues (SSI)-based e-module for increasing students' scientific literacy.

The e-module developed is based on Socio-Scientific Issues (SSI). Socio Scientific Issue is a learning approach that raises scientific topics that are controversial, dilemmatic and unstructured, so that students can be involved in dialogue, discussion and debate such as global warming, environmental pollution and others (Sibic & Topcu, 2020; Rohmaya, 2022). SSI topics are usually related to environmental aspects, health aspects, or social aspects (Nazilah et al, 2018). SSI topics include environmental pollution, global warming, food biotechnology, green technology, addictive and additive, civilization and the environment, interaction of living things and the environment, electricity and electrical technology in society, heredity or heredity, and energy in living systems (Nida et al, 2021).

The use of the context of socioscientific issues in learning is expected to facilitate students to be able to construct arguments related to scientific concepts and problems in society related to science (Setyaningsih et al, 2019). Socio-scientific issues in teaching materials can facilitate students to get closer to social phenomena or issues so that they can apply their knowledge about science in different situations or contexts (Hernández-Ramos et al, 2021). So, it is hoped that students will better understand what they have learned during class. Based on the description above, there is a need for research on "the effectiveness of e-modules based on socio-scientific issues (SSI) to increase students' scientific literacy". It is hoped that research into the effectiveness of e-modules in the independent curriculum can improve students' literacy skills in understanding learning that is linked to controversial issues in society.

Method

This type of research is quasi-experimental research with a One Group Pretest-Posttest Design (Sugiyono, 2018). The research was conducted on students at MTs Nurul Iman Dasan Makam, Sukamulia District, East Lombok Regency. This research was preceded by the development of a socio-scientific issue (SSI) based e-module for science subjects through a Research and Development (R&D) approach adopting the ADDIE development model (Frankel et al, 2012). Development activities consist of 5 stages, namely analysis, design, development, implementation, evaluation. The results of the development research concluded that the validation of SSI-based e-modules is very suitable for implementation in science learning at MTs/SMP (Rahmayanti et al, 2023). The ADDIE model development flow is presented in Figure 1.
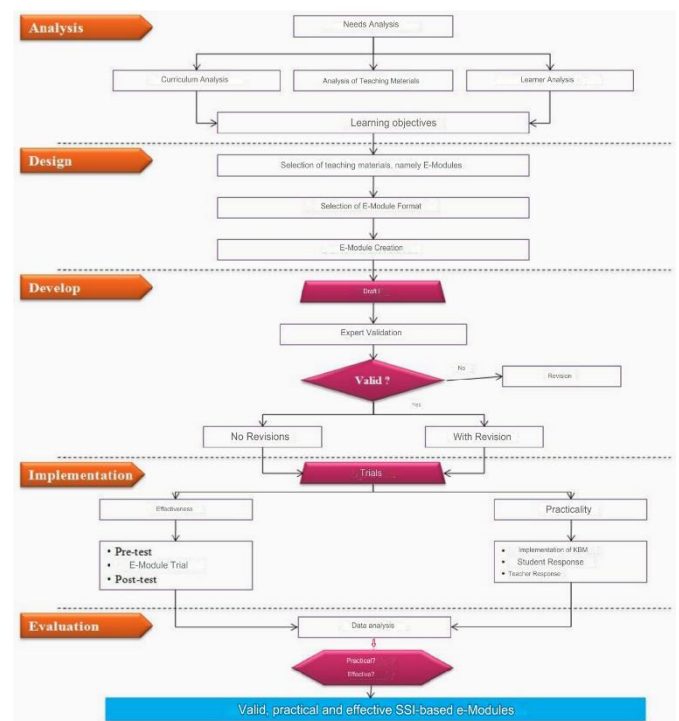

Figure 1. Product Development Procedure

The effectiveness test of SSI-based science e-modules is based on increasing students' scientific literacy. The test subjects for the implementation of the SSI-based science e-module were students in three classes VII of MTs Nurul Iman Dasan Makam, Sukamulia District, East Lombok Regency. Pretest activities are given at the beginning of learning and posttests are given at the end of learning. Product implementation uses a quasi-experimental design, namely One Group Pretest-Postest Design (Sugiyono, 2018) as follows:

Table 1. One Group Pretest-Posttest Design Research Design

Subject	Pre-test	Treatment	Post-test
One group	O_1	X	O_2

Information:
O1: giving initial tests
O2: giving the final test
X: implementation of SSI-based e-module

The instrument for the effectiveness of the socio-scientific issues Based e-module used is the scientific literacy test. The scientific literacy test is given at the beginning of the lesson and at the end of the lesson. The scientific literacy test is structured in the form of multiple choice with 20 questions. The effectiveness percentage value obtained is then interpreted based on the effectiveness criteria according to Arikunto on a scale of 1-4.

Table 2. Percentage of Product Effectiveness Criteria

Percentage (%)	Criteria
0-25	Ineffective
26-50	Less effective
51-75	Effective
76-100	Very effective

(Arikunto, 2013)

Effectiveness data obtained from the results of the initial and final tests on scientific literacy abilities were analyzed using the N-gain test to determine the increase in students' scientific literacy. The data analyzed is in the form of students' pretest scores and posttest scores using the following equation 1.

$$N - gain = \frac{Spost - Spre}{Smaks - Spre} \quad (1)$$

(Hake, 2002)
Information:
Spss: Posttest value
Bed Sheet: Pretest value
Enter: Maximum value

The N-gain is categorized based on Table 3:

Table 3. N-gain Criteria

N-Gain	Category
g > 0.70	Tall
0.30 < g ≤ 0.70	Currently
g ≤ 30	Low

(Arham & Dwiningsih, 2016)

Result and Discussion

The implementation results were carried out to determine the effectiveness of the SSI-based e-module on substance change material. Several displays of Socio-
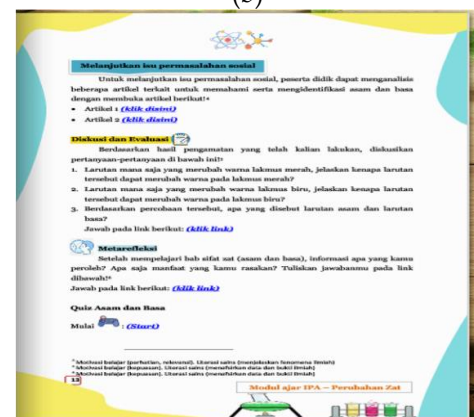
Scientific Issues (SSI) based e-modules are presented in Figure 2. Data on increasing scientific literacy was collected using a scientific literacy test instrument.
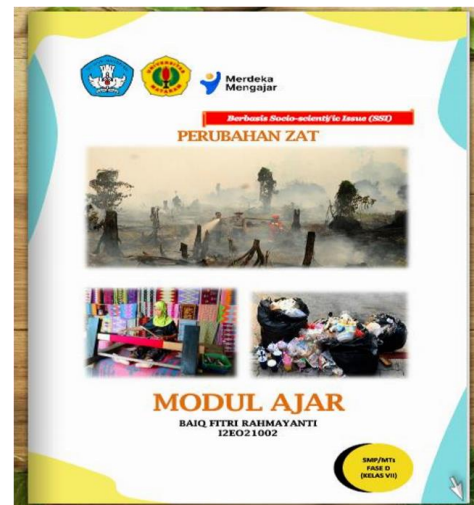
(a)

(b)

(c)

Figure 2. (a) Cover page; (b) learning activity page; (c) Discussion and evaluation questions page

SSI-based e-modules can be used as an alternative learning resource in science learning, especially in material on changes in substances to increase students' learning motivation and scientific literacy. Preparation of SSI-based e-modules developed in accordance with the guidelines for compiling learning modules. However, the e-module developed has been applied with stages of the SSI approach which are integrated with indicators of learning motivation and scientific literacy. Data on increasing scientific literacy was collected using a scientific literacy test instrument in Table 4.

**Table 4.** Results of N-Gain Analysis of Scientific Literacy

Class	Pretest Average	Posttest Average	Average N-Gain	Category
7A	33.75	61.75	0.42	Currently
7B	28.61	67.78	0.55	Currently
7C	29.50	60.50	0.44	Currently
Total	30.62	63.34	0.47	Currently

The scientific literacy ability of the class 7B test group was better than classes 7A and 7C. These results are based on the average pretest score and the average posttest score on the N-gain value obtained. The pretest average for the class 7A trial group was 33.75, class 7B was 28.61, and class 7C was 29.50. The posttest average for the class 7A trial group was 61.75, class 7B was 67.78, and class 7C was 60.50. Thus, the average N-gain value for class 7A is 0.42 with the criteria for a "medium" increase. The average N-gain value for class 7B is 0.55 with "medium" increase criteria, and the average N-gain value for class 7C is 0.44 with "medium" increase criteria. The increase in the initial test (pretest) and final test (posttest) after implementing the SSI-based e-module was quite significant with a total N-gain of 0.47 in the medium category.

This shows that students have understood and understood the material being taught so that they can answer the multiple choices final test (posttest) questions on scientific literacy on material changes in substances quite well. Increasing students' scientific literacy skills can also be seen from the scientific literacy competency indicators regarding changes in substances. Data on increasing scientific literacy competency indicators can be seen in Figure 3.

Based on the data in Figure 3, the average value of each indicator of scientific literacy competency scores quite well. Even though one indicator in each class got the lowest average score in ILS 3, the results of the analysis of the increase in each indicator of scientific literacy show good criteria in ILS 1 and ILS 2, because students already know their own initial understanding regarding the material covered. taught as the main key to the science phenomena text, then from this text

students can answer the questions well and correctly. This shows that students' ability to answer questions in this competency aspect is because students already know their own initial understanding regarding the material being taught as the main key to the science phenomena text questions, which then from the text students can answer. questions properly and correctly (Dewi & Rochintaniawati, 2016).
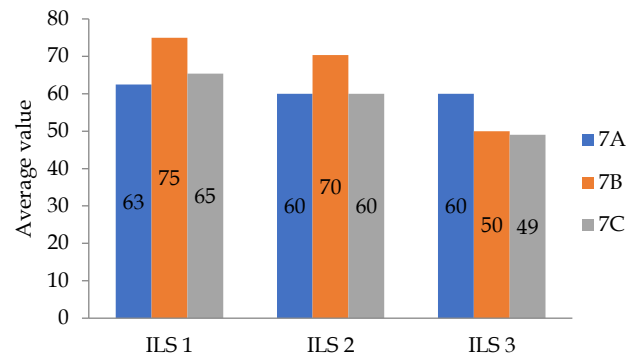
Figure 3. Improvement of Learning Indicators for Science Literacy Competency Aspects for Classes 7A, 7B and 7C
Information:
ILS 1: Explain phenomena scientifically
ILS 2: Evaluate and design scientific investigations
ILS 3: Interpret data and evidence scientifically

The increase in students' scientific literacy is due to the delivery of the concept of changes in substances in SSI-based e-modules featuring many contexts that are close to students, thereby stimulating their curiosity and making them enthusiastic about searching for, exploring and exploring information from the material they study (Bahriah, 2015). The SSI-based e-module on substance change material is effectively used to increase scientific literacy. Students' participation in SSI allows them to increase their conceptual understanding and interest in science (Espeja & Couso, 2020).

The learning process by applying the SSI approach to the competency to explain phenomena scientifically requires students to create scientific questions, apply concepts based on prior knowledge or basic knowledge that students have, and provide predictions or answers to scientific questions in accordance with the concepts (Rohmi, 2017; Bahriah, 2015) the aim is for students to be able to remember appropriate content knowledge in a given situation and use it to interpret and provide an explanation of the proposed phenomenon (OECD, 2017). The initial knowledge of students has been well constructed within each individual and can be connected to the real world, namely in the environment around where students live (Zeidler et al, 2019). This principle is related to the principle of constructivism which focuses on the active process of the individual and the process of organizing nature and its surroundings so

that an understanding is formed from knowledge (Dewi & Rochintaniawati, 2016).

Scientific literacy in ILS 3 is not going well. This is because students rarely do science learning practicums so that students have difficulty interpreting scientific data and evidence from the practicum results. An indicator of competence in interpreting data and evidence scientifically is the ability to analyze and interpret data. Students are less able to discuss, present and provide conclusions based on the results of the practicum carried out. The difficulty in answering questions on this competency aspect is also because in the trials carried out, the application of SSI-based e-modules to increase scientific literacy was still limited because this research was only carried out during three meetings.

In this indicator, students are required to analyze and evaluate experimental data in the form of tables or graphs and provide relevant conclusions based on experimental data (Rohmi, 2017). Giving assignments trains students to be independent and responsible for the tasks given and invites students to be actively involved in learning (Atmojp & Nugroho, 2020). In designing practical activities that will be carried out, students also collect information and process data (Rostikawati & Permanasari, 2016). This is in accordance with constructivist theory because students build their own knowledge based on the tasks given. Apart from that, group practicum is also in accordance with Vygotsky's theory because students carry out social interactions during the practicum, thereby training students to respect each other and develop communication skills (Rohmi, 2017).

Conclusion

The research results show that the average N-gain value for students' scientific literacy is 0.47, which is included in the medium criteria. Thus, it can be concluded that the implementation of the SSI-based science e-module is quite effective in increasing students' scientific literacy so that it can be used as a teaching material for science learning.

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