JESE 3 (1) (2023)

Journal of Environmental and Science Education

http://journal.unnes.ac.id/sju/index.php/jese

Development of Environmental Pollution E-Module Containing Socio Scientific Issue to Train Students' Scientific Literacy

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DOI: https://doi.org/10.15294/jese.v3i1.59915

Article Info

Received 4 February 2023
Accepted 27 March 2023
Published 28 April 2023

Keywords:
E-module,
Socio Scientific Issue,
Scientific Literacy

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Abstract

This study aims to analyze the characteristics, validity, readability of the E-module and the profile of students' scientific literacy after using the E-module. The design of this research is Research and Development (R&D), using the Sugiyono development model which consists of ten steps, potential and problems, data collection, product design, design validation, design revisions, product trials, product revisions, usage trials, product revisions, and mass production. The research subjects were VII grade students of SMP N 10 Magelang. The average score by the media validator is 96.25% very valid criteria and the material validator is 94.16% very valid criteria. The average score of the small-scale readability test is 91.60% and the average on the large-scale is 92.50% very good category. Based on the results of student scientific literacy profil 6.25% students are in the low scientific literacy, 13% students are in the medium category, 56.25% students are in the high category and 25% students are in the very high category. Based on the results of the study, it can be concluded that the environmental pollution E-module containing the Socio Scientific Issue is valid for use in science learning and can train students' scientific literacy skill.

p-ISSN 2797-0175
e-ISSN 2775-2518

INTRODUCTION

Science learning in the classroom has a role in developing the ability to understand the use of science effectively in everyday life and social responsibility (Dragos & Mih, 2015). The meaning of science learning for students can be obtained if students have good scientific literacy skills (Nanang, 2014). This is in accordance with Nofiana & Julianto (2018) which states that one of the keys to success in science learning according to the 21st century is science literacy. Therefore, scientific literacy is indispensable in preparing individuals to enter the modern world.

Scientific literacy according to PISA (Program for International Student Assessment) 2015 is defined as the ability to apply science in understanding and solving scientific and social problems in life (Yuliastini et al., 2016). Improving scientific literacy must be carried out for all educational institutions in Indonesia because scientific literacy skills in Indonesia are in the low category. Based on the results of the 2018 PISA, Indonesian students are ranked 72 out of 79 test-taking countries. PISA 2015 explains that aspects of scientific literacy consist of four aspects including context aspects, competency aspects, knowledge aspects and attitude aspects.

Based on the results of observations at SMP N 10 Magelang, it can be said that students' scientific literacy skills is quite low. Students' scientific literacy ability is limited to the tasks given by the teacher according to the book and has not been linked to environmental problems. Teaching materials commonly used by students in online learning activities are PPT, the material in PDF text and student books, so there is still less use of technology -based modules.

Based on this, a potential learning strategy to be applied in the classroom to train students' scientific literacy is Socio Scientific Issues (SSI) based learning. SSI- is learning that presents social issues in society that are conceptually related to science (Nuangchalerm, 2010). SSI applied in science learning is expected to provide a more meaningful learning experience. . One of the science materials that is very close to the context in real life is environmental pollution material (Hendri & Defianti, 2015).

So that an E-module was developed which is equipped with materials, videos, pictures, quizzes and online worksheets using a live worksheet, making it easier for students to learn because the materials, worksheets, and evaluations are contained in one E-module and can be done directly online via the device.

METHOD

This research is a development research with a development model according to Sugiyono (2015) consist of 10 steps consisting of (1) potential and problems, observation to identify problems, (2) data collection, to support research and product design; (3) Product design, product concept design stage; (4) Design validation, assessing product design, Validation is carried out by 5 media validators and 5 material validators; (5) Design revision, E-module improvement activities according to the validator's suggestion; (6) Product trials, including the E-module readability test and conducted in class VII A; (7) Product revision, product improvement activities based on the results of the readability test; (8) Trial of use, knowing the readability of E-module on a large scale and testing of scientific literacy questions; (9) Revision of the product, if in the trial use it is found that there is a shortage of the developed E-module; (10) Mass product, namely distributing the E-module link to all class VII students at SMP N 10 Magelang.

The instruments used in this study were material and media t validation sheets, E-module readability sheets, and scientific literacy tes. then the results of the validation by the media validator and the material are analyzed according to the formula

$$P = \frac{f}{N} x\ 100\%$$

Information:
P = Percentage of scores obtained
F = Total score obtained
N = Total maximum score

And then categorized into validation criteria according to Arikunto:

Table 1. Validation Assessment Category

Persentage	Category
81,25% < skor ≤ 100%	Very valid
62,50% < skor ≤ 81,25%	Valid
43,75% < skor ≤ 62,50%	Quite valid
25,00% ≤ skor ≤ 43,75%	Not valid

(Arikunto, 2012)

The data on the results of students' scientific literacy questions were analyzed using the formula

$$NP = \frac{Score\ obtained}{Score\ maximum}\ x\ 100\%$$

Information:
NP = percentage value

The percentage value is categorized into the category of scientific literacy according to Purwanto

Table 2. Scientific literacy category

Interval	Category
86% < P ≤ 100%	Very high
75% < P ≤ 86%	High
60% < P ≤ 75%	Medium
54% < P ≤ 60%	Low
54% < P	Very low

(Purwanto, 2009)

RESULT AND DISCUSSION

This research is a research and development with the aim of knowing the validity, readability of the E-module and the profile of students' scientific literacy after using the E-module. The product developed is environmental pollution E-module containing Socio Scientific Issues contains environmental issues that can help students understand environmental pollution material and train scientific literacy. The e-module was developed using the Canva app and the Heyzine flipbook. Here's a look at the E-module design using the Canva app

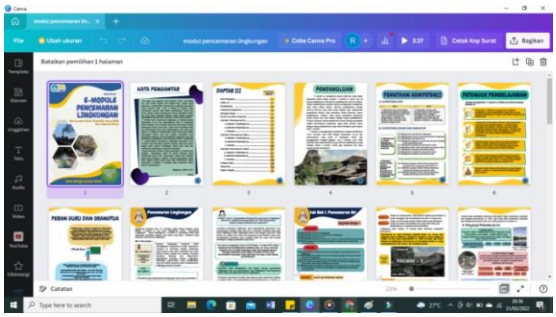

Figure 1. E-module design view

The E-module form of a flipbook so that students can open and turn pages on the E-module like opening a printed book. The e-module developed has characteristics according to the characteristics of the E-module according to the Ministry of Education and Culture in 2017 including:

1. Self-instructional

The existence of KI, KD, indicators and learning objectives on environmental pollution material is equipped with LKPD, quizzes and evaluations that allow students to study independently.

2. Self contained

All learning materials from one unit of competency being studied are contained in one complete module. The material in the E-module is divided into 3 sub-chapters to make it easier for students to learn the material thoroughly.

3. Stand alone

The developed e-module does not contain Stand alone characteristics because the use of the E-module depends on other media, namely quizzes, worksheets and evaluations. So that the E-module requires the use of other media together to complete the learning activities contained in the E-module.

4. Adaptive

E-module has adaptive power to the development of science and technology.

5. User friendly

The developed e-module can be accessed via laptop, notebook, computer and android.

6. Be consistent in the use of letters, spacing and layout

The presentation of the material in the E-module uses 3 types of letters, namely Chewy, Coco Gothic and Alata so that students do not get bored quickly and make it easier for students to learn.

7. Electronic based

The e-module is in the form of a flipbook and is distributed using links that can be accessed using Android and the internet.

8. Take advantage of the media function

E-module was developed by utilizing several functions of electronic media such as video, the existence of links to work on LKPD, quizzes, evaluation questions. Thus, helping students to obtain learning materials easily.

9. Take advantage of various features

The resulting e-module contains features that make it easier for students or users to operate it.

10. Interesting

The design, color combination, arrangement of elements and layout used in the E-module are proportional and attractive.

The results of the media expert's assessment of the E-module are presented in table 3.

Table 3 Media validation data

Validator	Institute	Percentage (%)	Category
1	UNNES	96,87	Very valid
2	UNS	93,75	Very valid
3	IAIN Kudus	93,75	Very valid
4	SMP N 10 Magelang	100	Very valid
5	SMP N 10 Magelang	96,87	Very valid
	Average	**96,25**	**Very valid**

The results of the assessment by 5 media validators showed that the E-module obtained an average percentage of 96.25% in the very valid category. The evaluation of the media aspect of the E-module is carried out by the media validator covering 2 aspects, namely the aspect of the feasibility of the graphic and the aspect of the presentation. The aspect of the feasibility of graphics received a very positive response from media validators. The cover design that was developed was arranged in an attractive manner with pictures related to environmental pollution materials.

The media validator gives suggestions that the sound in the supporting video is not clean enough so that it is necessary to revise the dubbing to make it more comfortable to listen to. Auliah et al., (2020) say that digital modules can be said to be effective if the module contains simple instructions and commands, the navigation buttons are easy to use, the language used is easy to understand, audio and video can be heard clearly.

The second aspect is the presentation of the E-module. The developed e-module contains clear images and videos so that it can make it easier for students to understand the material. This is in accordance with the results of research from Pramana et al. (2020) which states that the readability of texts and the presence of learning videos can increase motivation and make it easier for students to absorb information.

The results of the material validator's assessment of the E-module are presented in table 4.

Table 4 Material validation data

Validator	Institute	Percentage (%)	Category
1	UNNES	93,75	Very valid
2	UNNES	95,83	Very valid
3	STKIP Pembangunan Indonesia	91,66	Very valid
4	SMP N 10 Magelang	93,75	Very valid
5	SMP N 10 Magelang	95,83	Very valid
Average		94,16	Very valid

The results of the assessment by 5 material validators showed that the E-module obtained an average percentage of 94.16% which was included in the very valid category for use in the readability test.

The evaluation of the material aspects of the E-module by the material validator includes 4 aspects, namely aspects of accuracy, presentation, language, and characteristics of the E-module. Aspects of the accuracy of the material i get an average score percentage of 100%. This shows that the material presented in the E-module is in accordance with KD, indicators and learning objectives. In accordance with this, Sitepu (2012) states that the feasibility of the content of the material includes 3 indicators, namely the suitability of the material with Core Competencies, Basic Competencies, and learning objectives.

The presentation aspect of the developed E-module material presents images and videos about environmental pollution around the Magelang area. The video presented is a video made by researchers to make it easier for students to understand the material and provide an overview of the polluted

environment in the surrounding environment. Some of the images presented were taken directly by the researcher according to the conditions in the surrounding environment and some were taken from various sources.

The linguistic aspect of the expert validation results showed that there were some writing and punctuation errors so that the linguistic aspect was improved. The choice and use of sentences in the module need to be considered so as not to cause double interpretation by the reader. According to Sujiono & Widiyatmoko (2014) the sentences used should be adjusted to the rules of Indonesian grammar and refer to EBI.

The fourth aspect of the characteristics of the E-module obtained an average score percentage of 96% with a very valid category. The e-module is prepared based on the Socio Scientific Issue, which means that the materials, examples, and exercises presented in the module contain problems and issues related to the surrounding environment. Contextual problems used in the module can build student interest in studying the material presented in the module (Sujiono & Widiyatmoko, 2014). The increase in scientific literacy because of the use of the SSI context is also supported by Pinzino (2012) who states that SSI-based learning can improve scientific literacy.

Media expert validators and material experts provide some suggestions and improvements to improve the E-module that has been developed is presented in Table 5

The E-module readability test was carried out in class VII with a sample of 32 students during a small-scale product trial and 60 students during a product usage test. The readability test was conducted to determine the readability of the E-module. The results of the E-module readability questionnaire by students are presented in Figure 2

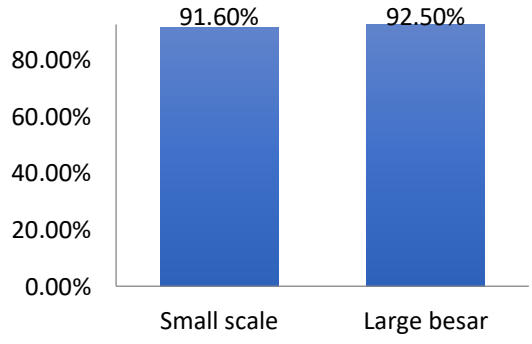

Figure 2 Percentage of readability of E-module

Table 5 Suggestions and improvements by validators

No	Suggestion	Result
1.	The sound on the supporting video is not clean, it needs a dubbing revision	Doing dubbing revisions on supporting videos
2.	The color that blocks the writing is better, a soft color	Changing a softer color to block LKPD link writing.
3.	Write down the source of the image if you take it from the internet. (Not google.com)	Adding the image source link contained in the E-module
4.	Revise the live worksheet button so as not to cause an assessment bias that is detrimental to students	Check and fix malfunctioning multiple-choice button
5.	There are some spelling and punctuation errors	Read the material and questions as a whole and make revisions.
6.	Some evaluation questions are structured with words that are too long	Revise questions no. 1, 4, 21, 25 so as not to confuse students

The readability questionnaire consists of two aspects of the assessment, namely the clarity of the E-module format and the presentation of the material. The results of the E-module and Socio Scientific Issue-based readability tests on a small and large scale obtained a very good category with an average score percentage of 91.60% and 92.50%.

Based on the results of the student readability questionnaire on the clarity aspect of the E-module format, the attractiveness of the display includes the selection of color combinations, selection of fonts, selection of audio, video, and animation. The typeface used is a Gothic sans serif type. The choice of font is intended so that the writing in the E-module is

easy to read and it is easier for students to understand the material.

In accordance with (Ali et al., 2013) which states that san serif type fonts are considered better used when the text is displayed on a computer screen. The display design is also designed to be simple to provide convenience to students. The insertion of videos and images in the E-module can make learning more interesting (Romayanti et al., 2020).

In the aspect of presenting the material, the developed E-module has a language that is in accordance with the level of emotional maturity of junior high school students. Rosyidah et al., (2013) stated that a good E-module uses a language that is appropriate to the level of student development, which will make it easier for students to understand the material.

Based on the readability test on a small and large scale, the developed SSI-based E-module can be stated to have very good readability. Student interest in learning is something important in supporting the achievement of learning objectives. Students who are interested in learning will find it easier to catch the material presented. If students' attention is focused on the learning process, students will play an active role and give a positive response (Nugraha et al., 2013).

The results of students' scientific literacy tests on environmental pollution materials can be shown in Table 6

Tabe 6 Categories of student scientific literacy

Interval	Categoryi	Total students	Persentage
86% < P ≤ 100%	Very high	8	25%
75% < P ≤ 86%	High	18	56,25%
60% < P ≤ 75%	Medium	4	12,50%
54% < P ≤ 60%	Low	2	6,25%
54% < P	Very low	0	0

The scientific literacy category of students was obtained based on the results of the scientific literacy test which included four aspects, namely knowledge, context, competence and scientific attitude. There are 25 scientific literacy questions consisting of 7 questions about the knowledge aspect, 7 questions about the context aspect, 9 questions about the competency aspect, and 2 questions about the attitude aspect. The results of students' scientific literacy tests in each aspect can be shown in Table 7

Table 7 The results of the analysis of the percentage of scientific literacy in each aspect

Aspect	Question	Persentage	Category
Knowledge	1,8,12,16, 17,20,21	88,17%	Very high
Context	3,9,10,13, 14,18,19,23, 25	85,20%	High
Competence	2,4,5,6,7,1 ,15,22,24	75,00%	Medium

In the aspect of science knowledge, it obtained an average score of 88.17% with a very high category. Analysis of students' scientific literacy skills in the knowledge aspect, it is known that students have mastered the knowledge aspect, which is more than 80%.

The use of Socio Scientific Issue-based E-modules can train students' scientific literacy. More than 50% of students are in the high scientific literacy category. The Socio Scientific Issue-based e-module is easy for students to understand because the SSI E-module begins with presenting issues that exist around students and is closely related to the context in real life so as to motivate students to interpret the subject matter they are studying. This statement is supported by findings (Zo`bi, 2014) which state that learning with the SSI approach can improve students' ability to make decisions related to controversial social issues.

The results of this study indicate that the use of E-module has an effect and is proven to be able to train students' scientific literacy. Socio Scientific Issue-based e-module can be used in learning because it can introduce scientific literacy (Sadler and Zeidler, 2004).

CONCLUSION

The validity of the environmental pollution E-module containing the Socio Scientific Issue consists of media and material aspects. The average percentage score of media validity is 96.25% with a very valid category and 94.16% material validity in a very valid category. The result of the average percentage of E-module readability by students on the small-scale test is 91.60% included in the very good category and the percentage on the large-scale test is 92.50% in the very good category. The results of the scientific literacy profile of class VII A students, namely 6.25% of students are in the low scientific literacy category, 12.50% of

students are in the medium literacy category, 25% of students are in the high scientific literacy category, and 56.25% are in the high scientific literacy category. very high scientific literacy

REFERENCES

Ali, A. Z. M., Wahid, R., Samsudin, K., & Idris, M. Z. (2013).Reading on the ComputerScreen: Does Font Type has Effects on WebText Readability? International Education Studies, 6(3), 26-35

Arikunto, S. (2012). *Dasar-Dasar Evaluasi Pendidikan*. Jakarta: Bumi Aksara.

Auliah, L., Syaiful, S., & Syamsurizal, S. (2020). Pengembangan Modul Digital Pembelajaran Matematika Berbasis Pendekatan Open Ended Untuk Meningkatkan Kemampuan Berpikir Kreatif Matematis. *Jurnal Pendidikan Matematika*, *11*(1), 13-24.

Dragoş, V., & Mih, V. (2015). Scientific literacy in school. *Procedia-Social and Behavioral Sciences*, *209*, 167-172.

Hendri, S., & Defianti, A. (2015). Membentuk Keterampilan Argumentasi Siswa Melalui Isu Sosial Ilmiah dalam Pembelajaran Sains. *Prosiding Simposium Inovasi dan Pembelajaran Sains*.

Kementerian Pendidikan dan Kebudayaan RI. (2017). Panduan Praktis Penyusunan E-Modul Pembelajaran. Direktorat Pembinaan SMA, Ditjen Pendidikan Dasar dan Menengah. Jakarta : DPSMA

Nanang, E. (2014). Identifikasi Kemampuan Siswa dalam Pembelajaran Biologi Ditinjau dari Aspek-aspek Literasi Sains. In *Seminar Nasional Pendidikan Sains IV 2014*. Sebelas Maret University.

Nofiana, M., & Julianto, T. (2018). Upaya Peningkatan Literasi Sains Siswa Melalui Pembelajaran Berbasis Keunggulan Lokal. *Biosfer: Jurnal Tadris Biologi*, *9*(1), 24-35.

Nuangchalerm, P. (2010). Engaging Students to Perceive Nature of Science Through Socioscientific Issues-Based Instruction. *European Journal of Social Sciences.* Vol 13 (1): 34-37

Nugraha, D. A., & Binadja, A. (2013). Pengembangan bahan ajar reaksi redoks bervisi SETS, berorientasi konstruktivistik. *Journal of Innovative Science Education*, *2*(1).

OECD. (2019). PISA 2018. PISA 2018 Result Combined Executive Summaries. PISAOECD Publishing.

Pinzino, D. W. (2012). Socioscientific Issues : A Path Towards Advanced ScientificLiteracy and Improved Conceptual Understanding of Socially Controversial Scientific Theories.

Pramana *et al*. (2020) Pramana, C. (2020). Pembelajaran Pendidikan Anak Usia Dini (PAUD) Dimasa Pandemi Covid-19. *Indonesian Journal of Early Childhood: Jurnal Dunia Anak Usia Dini*, *2*(2), 115-123.

Purwanto. (2009). Evaluasi Hasil Belajar. Surakarta: Pustaka Belajar

Romayanti, C., Sundaryono, A., & Handayani, D. (2020). Pengembangan e-modul kimia berbasis kemampuan berpikir kreatif dengan menggunakan Kvisoft Flipbook Maker. *Alotrop*, *4*(1).

Rosyidah, A. N., Sudarmin, S. S., & Siadi, K. K. (2013). Pengembangan Modul IPA Berbasis Etnosains Zat Aditif dalam Bahan Makanan untuk Kelas VIII SMP Negeri 1 Pegandon Kendal. *Unnes Science Education Journal*, *2*(1).

Sadler, T. D., Chambers, F. W., & Zeidler, D. L. (2004). Student conceptualizations of the nature of science in response to a socioscientific issue. *International Journal of Science Education*, *26*(4), 387-409.

Sitepu, B. P. (2012). Pengembangan Taman Bacaan Masyarakat Sebagai Sumber Belajar. *Jurnal Ilmiah Visi*, *7*(1), 42-56.

Sugiyono. 2015. *Metode Penelitian Kuantitatif, Kualitatif, dan RnD*. Bandung: Alfabeta.

Sujiono, S., & Widiyatmoko, A. (2014). Pengembangan modul IPA Terpadu berbasis problem based learning tema gerak untuk meningkatkan kemampuan berpikir kritis siswa. *Unnes Science Education Journal*, *3*(3).

Yuliastini, I. B., Rahayu, S., & Fajaroh, F. (2016). POGIL berkonteks socio scientific issues (SSI) dan literasi sains siswa SMK. In *Proseding Seminar Nasional Pendidikan IPA Pascasarjana UM* (Vol. 1, pp. 601-614).

Zo'bi, A. S. (2014). The Effect of Using Socio-Scientific Issues Approach in Teaching Environmental Issues on Improving the Students' Ability of Making Appropriate Decisions towards These Issues. *International Education Studies*, *7*(8), 113-123.