Developing E-Module Based on Socio-Scientific Issues to Improve Students Scientific Literacy

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Article Info	Abstract
	Program of literacy that is implemented in the school has yet to lead in science learning, this makes the students to be less conscious of the essence of science literacy in the everyday life of students. This study aims to analyze the validity, practicality and effectiveness of using e-Module based SSI in improving the scientific literacy of high school students. This research is research and development by adopting the ADDIE model. Sampling using purposive sampling method with a total of 57 students consisting of class XI IPA 1 and XI IPA 3 SMAN 1 Mayong Jepara. The results showed that the analysis of the validity of the development of e-Module according to the material experts and media obtained 85,71% and 94,64% with the criteria of very valid. The analysis of the practicality of the response of the students obtained a value of 3.25 with practical criteria, as well as on the response of the teacher values obtained 3,94 with the criteria very practical. Analysis of the effectiveness of the N-Gain value in the medium category and classical completeness XI IPA 1 obtained 85.18% and XI IPA 3 obtained 76.67%. Based on the results of the study, it can be concluded that the SSI-based e-Module material on the immune system developed is valid, practical and used in learning immune system materials and is effective in improving the scientific literacy skills of high school students.

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INTRODUCTION

The face of the 21st century in the sector of science and technology, students need to be equipped with 21st-century skills in science education. Science literacy is one of the skills that are needed in the literacy of the digital age. Science literacy is applied to express the extensive knowledge of science and the goal of science education (Gunstone, 2015). Scientific literacy is one of the fundamental achievements in 21st century skills in science education. The importance of science literacy widely to decision-making based on the information to analyze, synthesize and evaluate information. Given the information that is constantly evolving, which requires that the student have the capacity to manage and respond well to the problems. The literacy skills of science aims to prepare students to think in the rapidly evolving world of science and technology. Equipping students with scientific literacy is useful in student life after graduation by providing an experience in analyzing problems that are applied in learning. Science education in the early 21st century emphasizes the achievement of scientific literacy by students before graduating from school (Liu, 2009).

The ability of scientific literacy of students can be developed along with the issues that come from the community (Siribunnam et al., 2014). The direct and indirect effect of contextual factors on reading ability by integrating information about sources and content on socioscience problems has a positive influence on memory for contextual problems (Stang Lund et al., 2019). The problem of social-scientific can improve students ' ability in improving the decision on the issue of the environment and the decision issued include scientific thinking by considering comprehensively (Zo'bi, 2014).

The results of observations conducted in SMA Negeri 1 Mayong Jepara, that the literacy activities are held every Wednesday by reading a book themed common. Literacy movement has been carried out include the stages of habituation to read, and the development of interest in reading. However, the literacy movement has not been applied in learning, especially in science learning. Efforts to train students' scientific literacy skills can be done by compiling teaching materials that support students' scientific literacy needs through e-Modules based on socio-scientific issues (SSI).

Approach SSI be potentially used as the basis of learning science in school, because it can be made in connecting real problems in the community and foundation learning students in exploring issues related to the science content (Rostikawati & Permanasari, 2016). e-Module is designed with basic characteristics of the module and is integrated with the issues or the problems of day-to-day related to science so that the students understand the subject matter of biology, especially in the material of the immune system and improve the ability of scientific literacy of students. The use of the electronic module can improve the cognitive learning outcomes of students (Hapsari, 2016; Winarko et al., 2013).

The SSI strategy opens up possible outcomes that will create opportunities to emphasize students' value in knowledge and perspectives on social science-related issues. (Paraskeva-Hadjichambi et al., 2015). The context of the issues sosiosainstifik should be carefully selected by the teacher to ensure that students have the background knowledge to engage in argumentation (Dawson & Venville, 2010).

Related to the body's defense system against the health issues that occur in Indonesia such as the problem of the pros and cons of vaccines and disorders or abnormalities in the immune system that is associated with issues sosiosains. Issues concerning the health of the immune one at this time has become the talk of the common and appears as SSI. Problems in the context of SSI are complex problems and can lead to debate so that they do not have a definitive answer or have an open answer (Sadler et al., 2004). The context of SSI in the learning starts from the neighborhood nearby and have reality/meaning in everyday life, for example the reality of what happened in Indonesia, which is one of the vaccine, a vaccine that has the content of pork in Islam is haram become an issue or a matter of controversy vaccine in Indonesia (Wiyarsi & Çalik, 2019). Socio-science issues or problems related to vaccines have been widely reported in online media such as on CNN Indonesia and detik.com sites, regarding the

controversy over the MR vaccine based on halal and haram.

The implementation approach of SSI in a teaching material as an effort to develop teaching materials in improving the literacy skills of science students. In line with the Research done by Kartika et al., (2017; Rostikawati & Permanasari, (2016); Suarsana & Mahayukti, (2013) showing that the implementation of teaching materials with the context of SSI can increase the science literacy of students in the aspect of competence and declared valid and effective. The development of e-Module based SSI material immune system is designed to be easily understood, contains animated images and videos that explain the material of the immune system, and include exercises in each learning activity as well as its use can be done anywhere students learn because it can be accessed through a smartphone which owned by the students. therefore, this study aims to analyze the validity, practicality, and effectiveness of e-Module based SSI material of the immune system in improving the literacy skills of high school students' science.

METHODS

Methods in this study using the reference approach to Research and Development (R&D). The model used in ADDIE development is Analyze, Design, Develop, Implementation, and Evaluation. The subject of this research is 57 students of class XI IPA 1 and XI IPA 3 SMAN 1 Mayong Jepara. The selection of research class subjects used a purposive sampling technique. Indicators of scientific literacy ability are based on indicators by Chiappetta et al., (1991) including science as a body of knowledge, science as a way to investigate, science as a way of thinking, and the interaction of science, technology and society. The Data obtained in this study consists of data the validity of the e-Module through a questionnaire validation of material experts and media experts, data practicality through the student questionnaire responses and questionnaire responses of teachers, and data on the effectiveness of the value of science literacy and the classical completeness. The procedures in this study are as follows.
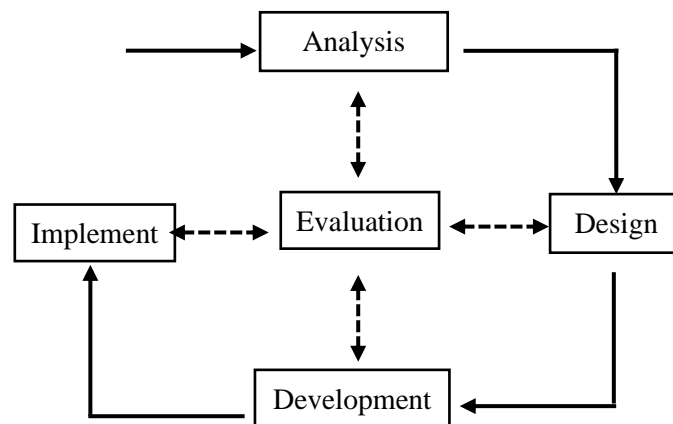
Figure 1. Stages of the ADDIE model (Shelton & Saltsman, 2011)

The first stage in the research is the analysis stage, which consists of needs analysis and curriculum analysis. Needs analysis was obtained by observing and interviewing teachers at SMA Negeri 1 Mayong Jepara. The second stage is design, at this stage is done by compiling Flowcharts as the basis for making e-Module development storyboards. The results of the design stage are obtained by displaying the contents and menu features of the e-Module which consists of the front page, home, introduction, KI KD & indicators, concept maps, learning activities, glossary, bibliography and exit. The content in the e-Module has a specificity related to immune system material related to socio-science issues, including the presentation of real examples of SSI problems such as health aspects of the immune system which are controversial issues discussed by the public, including immunity and vaccines. The

third stage is the development stage which includes the realization of the analysis and design stages, at this stage content validation is carried out by material and media experts. The e-Modul application is developed using the React Native mobile application framework. The fourth stage is the implementation of e-Module development in small-scale and large-scale trials. Small-scale trials were carried out in class XI IPA 2 and large-scale trials were carried out in class XI IPA 1 and XI IPA 3. And finally the fifth stage was evaluation carried out at each stage of product development, which consisted of input from supervisors, instrument validation questionnaires. material and media/IT experts, and student and teacher response questionnaire instruments.

Data analysis was carried out in steps starting with tabulating all the data obtained from each sheet of the validation and assessment instrument. Calculates the average score and converts the average score into a defined score category value. The total rating score is then converted to determine practicality. The conversion of teacher and student response scores while using e-Modules in learning is shown in Table 1 (Sari et al., 2015).

Table 1. Category of teacher and student response scores

Scores	Category
$3.26 < x \leq 4.00$	Very Good
$2.51 < x \leq 3.26$	Good
$1.76 < x \leq 2.51$	Not Good
$1.00 < x \leq 1.76$	Not Very Good

The effectiveness of the e-Module is shown from the acquisition of N-gain pretest and posttest scores and the achievement of classical completeness 75% of the number of students in the class achieving a score of 72 (Mulyasa, 2013). Calculation of the pretest and posttest scores using the following formula.

$$\text{Gain index} = \frac{Posttest\ score - Pretest\ score}{Maximum\ score - Pretest\ score}$$

The development of e-modules is said to be effective if it can increase students' mastery of concepts after using e-modules in learning indicated by the acquisition of N-gain in the medium category. The gain index criteria are shown in table 2.

Table 2. Gain index criteria

Gain Index	Criteria
$g \geq 0.70$	High
$0.30 \leq g < 0.70$	Moderate
$g < 0.30$	Low

RESULTS AND DISCUSSION

Validity of SSI-based e-Module

Assessment of the validity of the e-Module product prior to the product trial was carried out by the material expert validator covering the content of the e-Module and scientific literacy questions, while the media expert validator included media design and practicality. The e-Modul validity analysis technique uses a material validation questionnaire instrument consisting of four assessment components. The assessment component on the material aspect consists of introduction, content, learning, and evaluation. Meanwhile, the media aspect includes appearance, use, utilization.

Based on the data from the validation results by material and media experts, it was found that the validity of the material in the criteria was valid/good-very valid/very good. In Table 1, it is known that the value of the material aspect is in the very valid category with a value of 85.71%, while in the media aspect it is with a value of 94.64% and the category is very valid.

Table 3. e-Modul validation results based on material and media experts

Experts	Assesment Aspect	Average	Criteria
Material	Introduction	87.5	Very Valid
	Contents	81.3	Very Valid
	Learning Activities	86.5	Very Valid
	Evaluation	87.5	Very Valid
Percentage		85.71	Very Valid
Media	Appearance	96.3	Very Valid
	Use	97.2	Very Valid
	Utilization	87.5	Very Valid
Percentage		94.64	Very Valid

Evaluation of the validation of SSI-based e-Module materials and media with valid categories becomes the most important process in developing a teaching material, because the validity of a product determines the improvement and implications of a product (Nour et al., 2016). The lack of material aspects, namely the content component regarding examples that have not been comprehensive on each topic and the emphasis on important points in writing the content of the material. One aspect that must be considered in writing a module includes digestibility or understanding of the content by using bold or italic letters to observe important technical terms (Mulyati, 2002).

The validity of the SSI-based e-Modul media aspect obtained an assessment on very valid criteria with several suggestions given by the validator. The suggestions given related to the instructions for using the e-Module need to be added with video tutorials so that students are not confused in operating the e-Modul because online learning makes it easier to use the e-Modul, but videos are not yet possible to be displayed in the e-Modul. The LKS in the e-Modul is equipped with an assessment rubric so that it allows students to carry out self-assessments. The SSI-based e-Module on immune system material has valid criteria with some suggestions from expert validators. Valid instruments can obtain valid data so that they get the right measurements in measuring a product (Yusup, 2018). Based on expert judgment regarding the content or appearance of the e-Module, it has been adjusted to the suggestions given. Regarding the current (contextual) content, the immune system material in the e-Module is presented in each contextual topic in students' daily lives. SSI content display can be seen in Figure 2.
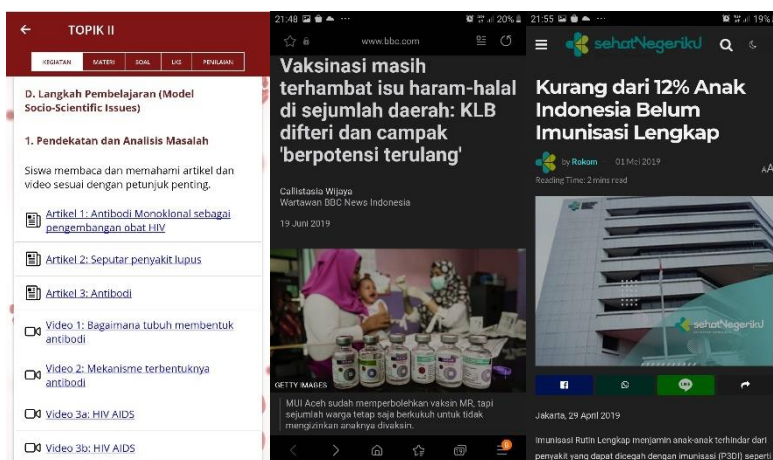
Figure 2. Display of presenting socioscience issues on e-modules

The online learning system that is currently set due to the Covid-19 pandemic situation has made issues regarding body defense a current issue, so that students can participate in SSI-based learning. This is in line with research conducted by Saraswati et al., (2018) which states that immune system material related to immunization is more interesting because it is directly related to events or problems that exist in the community. Case sources are obtained from online news that has been adapted to the learning topic.

The material of the present (contextual) material on the immune system in the e-Module is presented in each contextual topic in students' daily lives. The online learning system that is currently set due to the Covid-19 pandemic situation has made issues regarding body defense a current issue, so that students can participate in SSI-based learning. Socioscience issues related to current problems when presented to students using scientific literacy skills to propose facts based on data, scientific facts and experience. This is in accordance with research (Tanfiziyah & Rochintaniawati, 2021) that students are able to present socio-scientific issues with scientific facts/concepts, experiences and opinions/guesses.

Practicality of SSI-based e-Modules

Practical analysis aims to determine the quality of e-module development based on the results of teacher and student questionnaire responses while using e-modules in learning. The components in the teacher and student response questionnaire consist of learning aspects, display aspects, and usage aspects. The teacher's response questionnaire was assessed by practicing teachers and the field test student response questionnaire was 57 students. The results of the practicality value on student responses obtained a value of 3.25 with good criteria. While the teacher's response obtained a value of 3.94. Overall, the practicality test of teacher and student responses obtained a positive response to the development of the SSI-based e-Module on immune system materials.

Aspects in the practicality assessment of e-Modules have advantages because they are based on socio-science issues with controversial social issues related to science so that students can practice analyzing real issues in society. SSI-based

learning helps students associate socially relevant complex issues and engages students in the need for scientific literacy. This is in accordance with (Presley et al., 2013) that learning by exploring socio-science issues can support science learning and scientific literacy development. With learning that contains SSI, it can also develop analytical thinking and moral reasoning (Muang, 2010).

The development of e-Modules is packaged with Smartphone devices whose utilization has not been maximized in previous learning. The development of e-Modules is presented with an e-Module display that is presented in a clear design and is easily accessible to students. Attractive display design and in the form of electronic media students can find something through e-Modules (Budiarti et al., 2016).

**The effectiveness of SSI-based e-Modules in improving scientific literacy skills**

The effectiveness of this research is to determine the level of achievement by using the e-Module which was developed for learning in improving scientific literacy skills. The effectiveness was analyzed using a gain index obtained from the pretest and posttest values obtained by the gain value and classical completeness. Analysis of the scientific literacy value data at the pretest and posttest obtained differences, this indicates that there is an increase in the value before and after the use of the SSI-based e-Module for immune system materials.

The results of the pretest and posttest scores were 25.72 and 69.94. Furthermore, the N-Gain score was 0.42 which was included in the moderate criteria. The N-Gain value shows that the use of SSI-based e-Modules can improve students' scientific literacy skills in the medium category and in accordance with the achievement indicators in this study.

The effectiveness of e-Modules is also seen from classical completeness, that the average scientific literacy value obtained by students in science class 1 is 78.48 and science class 3 is 75.93. On the classical completeness of the school KKM, which is 72, there are students who did not complete the science class 1, namely 4 students and the science class 3 with 7 students. Furthermore, the completeness value obtained

was 85.18% for science class 1 and 76.67% for science class 3, so that both of them had achieved classical completeness of 75% of the total number of students. The increase in the average score on the posttest as a whole is shown by an increase in the aspects of students' scientific literacy. The data on the value of scientific literacy aspects can be seen in Figure 3.
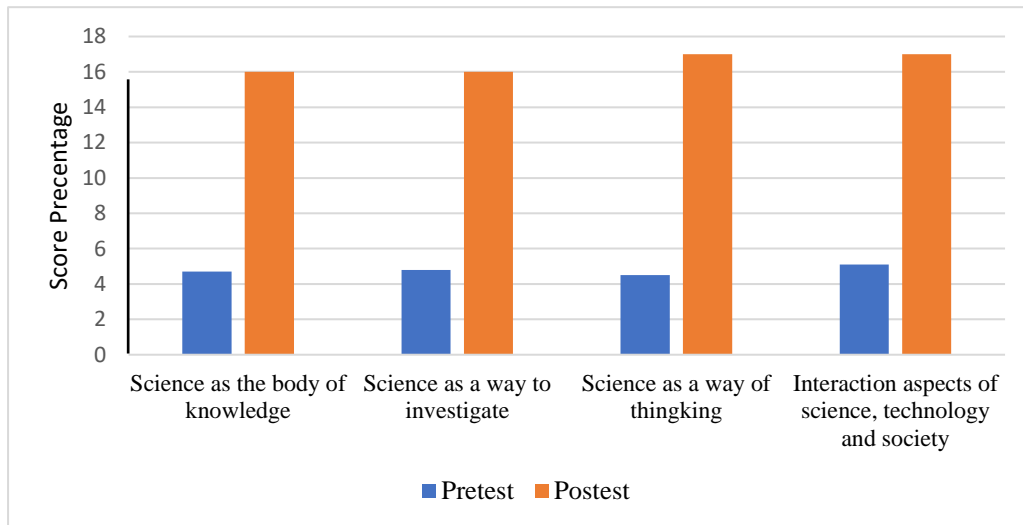
Figure 3. Increasing aspects of scientific literacy

The overall results of the analysis of scientific literacy aspects show differences in scientific literacy aspects seen from the average pretest and posttest scores (Figure 1). Based on the average value of each aspect of scientific literacy, there are differences in increasing scientific literacy skills using SSI-based e-Modules in learning.

The acquisition of scientific literacy scores on classical completeness from both classes shows that scientific literacy skills improve understanding of immune system concepts after students use the e-Module. Basically, scientific literacy skills have not been applied in science learning, especially biology. This is in accordance with the results of interviews with biology subject teachers who said that literacy applied in schools has not led to science learning. The implementation of literacy that has been carried out is to apply the habit of reading students at the beginning before class starts but only twice a week.

Student literacy is classified as low on scientific literacy, which is actually scientific literacy that really supports students' skills in 21st century learning. Literacy is important for students to know, understand, and apply and science teachers need to develop student literacy by developing teaching materials that integrate socio-

scientific issues in science learning (Asrizal et al., 2018; Kemendikbud, 2016; Widiyawati, 2020).

The development of e-Modules is considered effective in improving scientific literacy skills, because the material presented with descriptions and pictures is also complemented by videos and articles that visualize immune system material and socio-science issues. The SSI-based e-Module is one of the developments of teaching materials that integrates social issues related to science, which is presented in the form of an electronic module. Findings (Gucluer & Kesercioglu, 2012) that the use of activities that can develop students' scientific literacy skills can improve students' abilities both in science and technology.

Related research was conducted by Kartika et al. (2017) and Mudawamah, (2020) that SSI-based teaching materials improve students' scientific literacy in cognitive aspects. Then research by (Styati & Saptono, 2020) states that the use of learning activities with the use of socioscience issues can improve students' cognitive abilities on all bloom taxonomic indicators.

The electronic preparation of SSI-based modules helps students to support the achievement of students' functional scientific literacy and make learning more meaningful. SSI involves science-

related themes that are controversial, dilemmatic and social issues so that students are trained in dialogue and debate as to the importance of dealing with socio-science issues as content that is integrated with scientific literacy. Analyzing social problems related to science can yield significant advantages in the aspect of evidence-based reasoning (Kara, 2012; Nida et al., 2020; Wu & Tsai, 2011).

Student life today is inseparable from Smartphone technology, daily reality with gadgets supports its use, one of which is Smartphone-based e-Modules. As well as considering the use of SSI-based e-Modules as a supplement to improve students' abilities in the 21st Century learning industrial revolution era (Gufran & Mataya, 2020; Suastrawan et al., 2021).

The interconnectedness of the material of the immune system and SSI include controversial issues or problems regarding vaccines in Indonesia related to facts and hoaxes about halal and haram, cases of declining child immunization rates in Indonesia, sun bathing and antibody mechanisms. Socioscience issues in student learning activities train students to analyze biased information through scientific literacy skills in order to determine the decisions that must be taken.

The use of e-Modules for practical students on SSI instructions in understanding concept material in online learning situations. In line with research conducted by (Nazilah et al., 2019; Prasetyo et al., 2021; Robbia & Fuadi, 2020), that learning using e-Modules can develop students' scientific literacy skills in online learning. Utilization of technology in learning using learning strategies that stimulate students to argue and think critically can improve students' scientific literacy (Herlanti et al., 2019).

CONCLUSION

Based on the results of this study, conclusions that can be drawn include (1) Development of an e-Modul based on Socio-Scientific Issues material on the immune system was declared valid according to material and media experts, (2) e-Module based on Socio-Scientific Issues received a positive response so that practical use in learning in schools and (3)

Utilization of e-Module based on Socio-Scientific Issues material on the effective immune system to improve students' scientific literacy skills.

REFERENCES

Asrizal, Amran, A., Ananda, A., Festiyed, F., & Sumarmin, R. (2018). The development of integrated science instructional materials to improve students' digital literacy in scientific approach. *Jurnal Pendidikan IPA Indonesia*, *7*(4), 442–450.

Budiarti, S., Nuswowati, M., & Cahyono, E. (2016). Guided Inquiry Berbantuan E-Modul Untuk Meningkatkan Keterampilan Berpikir Kritis. *Journal of Innovative Science Education*, *1*(1), 1–9.

Chiappetta, E. L., Fillman, D. A., & Sethna, G. H. (1991). A method to quantify major themes of scientific literacy in science textbooks. *Journal of Research in Science Teaching*, *28*(8), 713–725.

Dawson, V. M., & Venville, G. (2010). Teaching strategies for developing students' argumentation skills about socioscientific issues in high school genetics. *Research in Science Education*, *40*(2), 133–148.

Gucluer, E., & Kesercioglu, T. (2012). The Effect of Using Activities Improving Scientific Literacy on Students' Achievement in Science and Technology Lesson. *Online Submission*, *1*(1), 8–13.

Gufran, G., & Mataya, I. (2020). Pemanfaatan E-Modul Berbasis Smartphone Sebagai Media Literasi Masyarakat. *JISIP (Jurnal Ilmu Sosial Dan Pendidikan)*, *4*(2).

Gunstone, R. (2015). Encyclopedia of Science Education. In *Encyclopedia of Science Education* (Issue May).

Hapsari, N. (2016). Pengembangan E-modul Pengayaan Materi Pertumbuhan dan Perkembangan untuk Meningkatkan Kemandirian Hasil Belajar. *Jurnal Pendidikan BIologi*, *5*(5), 23–31.

Herlanti, Y., Mardiati, Y., Rahmawati, R., Putri, A. M. K., Jamil, N., Miftahuzzakiyah, M., Sofyan, A., Zulfiani, Z., & Sugiarti, S. (2019). Finding Learning Strategy in

Improving Science Literacy. *Jurnal Penelitian Dan Pembelajaran IPA*, *5*(1), 59.

Kara, Y. (2012). Pre-service biology teachers' perceptions on the instruction of socio-scientific issues in the curriculum. *European Journal of Teacher Education*, *35*(1), 111–129.

Kartika, I., Kurniasih, S., & Indarini, D.P. (2017). Pengembangan Bahan Ajar Berbasis Socio-Scientific Issues Pada Materi Bioteknologi Untuk Meningkatkan Literasi Sains Siswa. *Journal of Science Education And Practice*.1-12.

Kemendikbud. (2016). *Pedoman Pelaksanaan Gerakan Nasional Literasi Bangsa (Mari Menjadi Bangsa Pembaca)*. 1.

Liu, X. (2009). Beyond science literacy: Science and the public. *International Journal of Environmental and Science Education*, *4*(3), 301–311.

Muang, A. (2010). Learning outcomes between Socioscientific Issues-Based Learning and Conventional Learning Activities. *Journal of Social Sciences, 6*(2), 240–243.

Mudawamah, K. (2020). Peningkatan Hasil Belajar dan Literasi Sains Siswa SMPN 1 Ngoro Mojokerto melalui Penerapan Pendekatan Saintifik Berbasis Socio-scientific issues (SSI). *Science Education and Application Journal*, *2*(2), 52.

Mulyasa. (2013). Menjadi guru profesional menciptakan pembelajaran kreatif dan menyenangkan. Bandung: Remaja Rosdakarya.

Mulyati, Yati. (2002). Penulisan Modul Bahan Ajar dan Diklat. *Pusat Pengembangan Penataran Guru Bahasa Universitas Pendidikan Indonesia*, 1-11.

Nazilah, N., Muharrami, L. K., Rosidi, I., Yuniasti, A., & Wulandari, R. (2019). Pengaruh Bahan Ajar Berbasis Socio-Scientific Issues Pada Materi Pemanasan Global Terhadap Kemampuan Literasi. *Natural Sceince Education Reseach*, *2*(1), 8–16.

Nida, S., Rahayu, S., & Eilks, I. (2020). A Survey of Indonesian Science Teachers' Experience and Perception toward Socio-Scientific Issues-Based Science Education. *Education Science, 10*(39), 1-15.

Nour, M., Chen, J., & Allman-Farinelli, M. (2016). Efficacy and external validity of electronic and mobile phone-based interventions promoting vegetable intake in young adults: Systematic review and meta-analysis . *Journal of Medical Internet Research*, *18*(4), 1–19.

Paraskeva-Hadjichambi, D., Hadjichambis, A. C., & Korfiatis, K. (2015). How Students' values are intertwined with decisions in a socio-scientific issue. *International Journal of Environmental and Science Education*, *10*(3), 493–513.

Prasetyo, D., Marianti, A., & Alimah, S. (2021). *Journal of Innovative Science Education Improvement of Students â€ᵀᴹ Science Literacy Skills Using STEM-Based*. *10*(37), 216–221.

Presley, M. L., Sickel, A. J., Muslu, N., Merle-, D., Witzig, S. B., Izci, K., & Sadler, T. D. (2013). *A Framework for Socio-scientifi c Issues Based Education*.

Robbia, A. Z., & Fuadi, H. (2020). Pengembangan Keterampilan Multimedia Interaktif Pembelajaran IPA Untuk Meningkatkan Literasi Sains Peserta Didik di Abad 21. *Jurnal Ilmiah Profesi Pendidikan*, *5*(2), 117–123.

Rostikawati, D. A., & Permanasari, A. (2016). Rekonstruksi bahan ajar dengan konteks socio-scientific issues pada materi zat aditif makanan untuk meningkatkan literasi sains siswa. *Jurnal Inovasi Pendidikan IPA*, *2*(2), 156.

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.

Saraswati, I., Saptono, S., & Susanti, R. (2018). The Effectiveness of Problem Based Learning Model Aided with Concept Mapping on the Analysis of Senior High School Students' Ability in Learning Material of Immune System. *Journal of Biology Education*, *7*(3), 273–281.

Sari, A., Ertikanto, C., & Suana, W. (2015). Pengembangan Lks Memanfaatkan Laboratorium Virtual Pada Materi Optik Fisis Dengan Pendekatan Saintifik. *Jurnal Pembelajaran Fisika Universitas Lampung*, *3*(2), 118605.

Shelton, K., & Saltsman, G. (2011). Applying the ADDIE Model to Online Instruction. *International Journal of Online Pedagogy and Course Design*, 566–568.

Siribunnam, S., Nuangchalerm, P., & Jansawang, N. (2014). Socio-Scientific Decision Making in the Science Classroom. *Online Submission*, *5*(4), 1777–1782.

Stang Lund, E., Bråten, I., Brandmo, C., Brante, E. W., & Strømsø, H. I. (2019). Direct and indirect effects of textual and individual factors on source-content integration when reading about a socio-scientific issue. *Reading and Writing*, *32*(2), 335–356.

Suarsana, I. M., & Mahayukti, G. A. (2013). Pengembangan E-Modul Berorientasi Pemecahan Masalah Untuk Meningkatkan Keterampilan Berpikir Kritis Mahasiswa. *Jurnal Nasional Pendidikan Teknik Informatika (JANAPATI)*, *2*(3), 193.

Suastrawan, K. E., Suardana, I. N., & Sudiatmika, A. A. I. A. R. (2021). The Effectiveness of Science E-Modules for Class VII Junior High Schools Based on Socioscientific Issues to Improve Students Critical Thinking Skills. *Journal of Science Education Research, 5*(2), 1–9.

Tanfiziyah, R., & Rochintaniawati, D. (2021). Profil Kemampuan Argumentasi Siswa Mengenai Isu Sosiosaintifik dalam Pembelajaran Online. *BIOSFER : Jurnal Biologi Dan Pendidikan Biologi*, *6*(1).

Widiyawati, Y. (2020). Global warming & climate change: Integration of socio-scientific issues to enhance scientific literacy. *Journal of Physics: Conference Series*, *1511*(1).

Winarko, A. S., Sunarno, W., Masykuri, M., Studi, P., Sains, P., Pascasarjana, P., & Sebelas, U. (2013). Pada Materi Sistem Indera Kelas Xi Sma Negeri 3 Ponorogo. *Bioedukasi*, *6*(58–75).

Wiyarsi, A., & Çalik, M. (2019). Revisiting the scientific habits of mind scale for socio-scientific issues in the Indonesian context. *International Journal of Science Education*, *41*(17), 2430–2447.

Wu, Y. T., & Tsai, C. C. (2011). High school students' informal reasoning regarding a socio-scientific issue, with relation to scientific epistemological beliefs and cognitive structures. *International Journal of Science Education*, *33*(3), 371–400.

Yusup, F. (2018). Uji Validitas dan Reliabilitas Instrumen Penelitian Kuantitatif. *Jurnal Tarbiyah : Jurnal Ilmiah Kependidikan*, *7*(1), 17–23.

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.