

Development of Learning Web to Improve Junior High School Students' Scientific Literacy

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ABSTRACT: This study aims to produce a learning web that can improve the scientific literacy of junior high school students. This study used the Research and Development method with a 4D design modified into 3D: the definition stage, the design stage, and the development stage. The research subjects were 35 eighth-grade students in junior high school. The instruments used in this study consisted of a multiple-choice test to capture the achievement of the content, students' science competence and knowledge, an attitude scale to capture students' scientific attitudes, and student response questionnaires to the learning web. The results showed that learning science using the learning web could improve scientific literacy skills in the medium category. Based on the results and data analysis, the increase in learning outcomes calculated using the N-Gain Test with an average gain of 55.89% is in the medium criteria, indicating a positive difference between learning outcomes before and after learning activities. The responses from students and teachers to the learning web are generally positive and supportive of its development and use.

Keywords: Learning Web, Scientific Literacy, Junior High School Students

INTRODUCTION

Students' scientific literacy worldwide is measured by several reliable studies, such as PISA (Program for International Student Assessment) and TIMSS (Trends in International Mathematics and Science Study) (Fuadi et al., 2020). PISA is carried out by the OECD (Organization for Economic Co-operation & Development), and the UNESCO Institute for Statistics carries out TIMSS. The PISA assessment tests the abilities of students aged 15 years or ninth graders of junior high school and tenth graders of senior high school. TIMSS assessment tests the abilities of students aged 9 and 12 years or fourth and eighth graders (Chandra & Royanto, 2019). These two science literacy competitions are conducted assuming that students' scientific literacy must be built from an early age.

The OECD report shows that the scientific literacy ranking of Indonesian students was 38th out of 41 countries in 2000, 38th out of 40 in 2003, 53rd out of 57 in 2006, 38th out of 40 in 2009, and 62nd out of 70 in 2015 (Seprianto, 2020). Based on these data, Indonesian students' scientific literacy skills need improvement. This report is a severe problem because Indonesian students' achievement tends to be low (Hardjo et al., 2018). Rubini et al. (2016) stated that

students' scientific literacy achievement had not shown satisfactory results, so scientific literacy achievement in Indonesia was still relatively low.

The lack of interest in science and a tendency to fear science material is due to the lack of relevance in teaching science to everyday life or learning that is not contextual and gives misconceptions (Fuadi et al., 2020). If we pay attention, issues around science currently dominate the conversation in mass media, such as newspapers and magazines. According to Hazen, it is as easy as understanding news about politics, sports, or the arts if one can understand scientific issues in the mass media, or is called scientifically literate. Hazen said, "Scientific literacy is a person's ability to combine concepts, history, and philosophy that help us to understand scientific issues in life" (Martinah et al., 2022).

Scientific literacy is considered a measure of a country's high and low quality of science education. Scientific literacy is considered important because the main capacity of scientific literacy is scientific thinking (Ardianto & Rubini, 2016). Scientific thinking is a demand of all citizens, not just science. DeBoer stated that scientific literacy is important for every citizen (Pratiwi et al., 2019). Applying scientific literacy to each other's lives means they can be part of the knowledge environment in society (Yuliasih, 2022). A scientifically literate person is expected to have the necessary competencies to fulfill his or her needs in various situations, namely to learn further and live in a society influenced by science and technology's development (Yuliati, 2017).

Multimedia learning is one computer-based media that can be developed to help students and teachers during the learning process to improve students' scientific literacy (Juniati et al., 2020). Teachers who act as facilitators in learning help overcome the difficulties experienced by students and reinforce the concepts obtained by students during the learning process (Rubini et al., 2016). In line with this, the Ministry of Education and Culture has a strategic plan related to strengthening and expanding the use of ICT in education, including facilitating teaching and learning processes such as e-learning (Gani, 2016).

Fitri (2021) stated that what is interesting about computer-assisted learning is the display of various images, graphics, sounds, and animations. Interactive multimedia is widely used in various fields, especially web-based multimedia. The use of web-based multimedia in learning has the potential to help overcome the limitations of space, time, and process (Yuningsih, 2020). Objects that are too large or small or events that take too long or short, dangerous, and complex can be handled with web-based multimedia (Ilmiani et al., 2020). Hassan (2021) argued that using the learning web would provide opportunities for students to get teaching close to real situations and comprehensive interactions.

The development of an integrated science learning web is very prospective as a form of contribution in adjusting to the 2013 curriculum. The undeveloped science materials in junior high schools are ecosystems. This material is broad and general to cover science concepts in junior high schools. In addition, ecosystem materials can also facilitate students in improving scientific literacy because this theme includes science content and daily life applications, is contextual, and includes scientific competencies. It makes ecosystem material essential to develop. Based on the problems and background, the specific purpose of this research is to

develop a learning web that can improve the scientific literacy of junior high school students on ecosystem materials.

METHOD

This study used Research and Development (R&D) method, referring to Thiagarajan's 4D, which consists of Define, Design, Develop, and Disseminate stages (Fernando, 2022). In this study, it was modified into 3D: Define, Design, and Develop. This model is universal. It can be used for software development and test kits. The steps are more superficial, easy to implement in the field, and the sequence of each step is systematic. The define stage is done by preparing the initial design through literature studies (assessment of scientific literacy and web software) and standard content analysis for science subjects. The results will be used as the basis for conducting the design stage, where the researchers design a science learning web and compile research instruments. The develop stage is carried out to validate and develop the product, and produce products that have been tested through trials. Three experts validated the developed product: material experts, media experts, and teachers. After the learning multimedia was revised, a limited trial was conducted on 35 eighth-grade students in junior high school in the science learning of ecosystem materials.

Qualitative data is used to determine the feasibility and quality of the developed learning web, while quantitative data is used to determine the increase in students' scientific literacy. The types of instruments used in this study were questionnaires on the feasibility of learning webs by media experts and material experts, questionnaires on teacher and student responses to the use of learning webs, and scientific literacy instruments in the form of multiple-choice tests which were arranged based on the domain of scientific literacy: the domain of scientific competence, domain knowledge of science and the domain of students' attitudes towards science. The scientific competencies in developed scientific literacy instruments include the explanation of scientific phenomena (Sukowati & Rusilowati, 2016). The selected contexts in the developed scientific literacy instruments are life and health, earth and the environment, and technology. The selected context is adjusted to the characteristics of the selected basic competencies in the ecosystem material.

The quantitative data analysis technique is scientific literacy analysis, calculated using the N-Gain value. This analysis aims to determine the increase in the pre-test and post-test of scientific literacy using the learning web. The calculation of N-Gain is done by looking at the difference in students' pre-test and post-test scores on scientific literacy. The quantitative data in this study are the results of the feasibility test of the learning web by media and material experts and questionnaires for teachers and students' responses to the use of the learning web. The results of the feasibility test of the learning web were analyzed descriptively and statistically. It was converted into a transcription in the form of a discourse that could support the analysis of research data.

RESULTS AND DISCUSSION

The developed learning web is designed by presenting science material on ecosystems to make students understand natural phenomena in everyday life. Multimedia in this learning web has a design that was developed based on the domain of scientific literacy. The content of the scientific literacy domain in the multimedia design in this learning web consists of context, scientific competence, and scientific knowledge (Sukowati & Rusilowati, 2016).

At the develop stage, web-based learning multimedia was produced and validated by three lecturers and two science teachers. The validation of the feasibility of learning multimedia by experts emphasizes the assessment of aspects and indicators of basic competence, content aspects, linguistic aspects, design aspects, and feedback aspects. The results of web-based multimedia validation by media experts are presented in Table 1.

Table 1. Multimedia Validation Analysis by Media Experts

Rated aspect	% Score		Average	Category
	Validator 1	Validator 2		
Basic competencies and indicators	75	75	75	Good
Contents	75	100	87.5	Very good
Language	75	83	79	Good
Design	91	75	83	Very good
Input	75	100	87.5	Very good

Based on the overall results of media expert validation of the developed learning web, it is declared feasible to be tested on students learning science on ecosystem materials. This proves that the learning web has met basic competence and indicators, content and language, design, and input criteria. Web-based learning can facilitate learning modalities and support science learning in increasing students' learning motivation (Purmadi & Surjono, 2016). The developed learning web can facilitate students' visual, auditory, and kinesthetic learning modalities through presentations, demonstrations, and experiments (Septian, 2018). It can be used both independently by students and with guidance by teachers so that the use is more effective and efficient.

After being validated, a limited trial was conducted on junior high school students with ecosystem material. During teaching activities, five aspects are observed in the learning process. The scores of observing learning activities by science teachers are presented in Table 2.

Table 2. Multimedia Feasibility Test Analysis by Teachers

Rated aspect	% Score		Average	Category
	Teacher 1	Teacher 2		
Learning Objectives in Multimedia	87.5	75	81.25	Very good
Science Literacy Content	87.5	81.25	84.37	Very good
Components in Multimedia	93.75	81.25	87.5	Very good
Ease of Operation	81.25	87.5	84.37	Very good
Studying Multimedia Potential	81.25	81.25	81.25	Very good

Based on the analysis of the web-based multimedia feasibility test by the science teacher, it can be declared suitable for students' learning use. The developed learning web is feasible in terms of learning objectives on the web, scientific literacy content, components in multimedia, ease of operation, and multimedia potential. The developed learning web integrates several forms of media such as sound, text, graphics, and animation on a computer (Priyambodo et al., 2012) by applying literacy-based science content. The results of this validation are used as additional data to answer problem formulation and research questions. The validation results from the teacher are also used as feedback to improve this learning multimedia. Basic competencies, indicators, and learning objectives are presented in multimedia, so students can directly access what learning objectives will be achieved after learning.

The basic competencies and indicators are under the current 2013 curriculum syllabus. Videos, pictures, language, and animations are presented following the development of junior high school children. This multimedia design is adapted to applications that are popularly used today so that students do not need too long to adjust to it. The overall achievement of scientific literacy includes students' pre-test and post-test scores in science competence and knowledge, all framed in a particular context for technology-themed science materials. N-gain science is used to determine the effectiveness of learning using multimedia learning to improve overall scientific literacy.

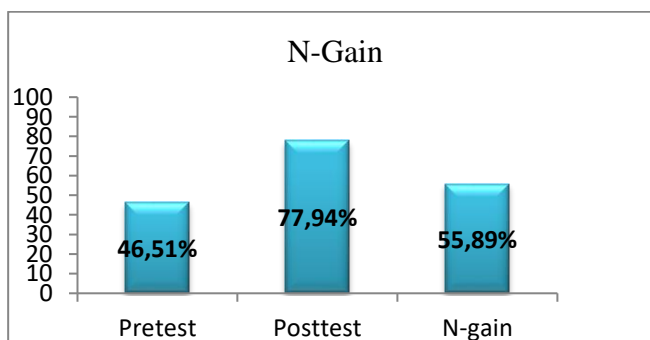


Figure 1. Overall Scientific Literacy Improvement

The results showed a significant increase in the post-test score of scientific literacy (Juniati et al., 2020) after using the learning web. The results of this study are in line with Latip and Permanasari (2016), who state that multimedia can improve scientific literacy in the medium category. It is also in line with Shalikhah (2017) who states that multimedia learning can create more meaningful learning that leads to deep understanding and applying concepts in authentic, new, and different conditions. Based on this, it can be stated that there is a relationship between meaningful learning and scientific literacy. In addition, the results of this study are also in line with Hussein (2015), who stated that visualization media could improve students' mastery and critical thinking skills, and Kimberly et al. (2018), who developed a project to combine online multimedia with face-to-face learning to improve scientific literacy.

The provision of attitude scale instruments in this study aims to see students' responses to students' interest in science and technology, conduct scientific investigations, and students' environmental awareness. An attitude scale instrument consisting of 15 statements was used to determine the achievement of the attitude domain. Each statement consisted of four answer choices: strongly agree, agree, disagree, and strongly disagree. The following are the results of the analysis of students' attitudes towards science, as in Table 3.

Table 3. Analysis of Students' Attitudes towards Science

No.	Indicator	Initial test (%)	Posttest (%)	N-Gain (%)
1.	Student interest in science and technology	72.14	85.18	46.8
2.	Do scientific research	73.29	83.29	37.4
3.	Environmental awareness	69.05	86.31	55.8

Overall, the increase in students' attitudes towards science was in the moderate category. The achievement of environmental awareness has the highest increase because, during learning, students are given learning materials that involve daily life activities. This study's results align with Ardianto and Rubini (2016), who state that there is an increase in the achievement of students' attitudes towards science after integrating science learning. The results of this study also follow Latip and Permanasari (2016), who states that the effectiveness of multimedia learning in improving the domain of students' attitudes toward science is in the medium category.

Messages delivered through the learning web use the language of instruction so that the ecosystem materials presented are easier to understand by students. Using this learning web, students are also invited to observe the impact of environmental damage on humans. The material taught is closely related to experience so that students can understand what must be done to increase their awareness of the surrounding environment. The success of multimedia in

improving students' attitudes towards science is due to the developed multimedia leading to the formation of students' attitudes towards science (Juniati et al., 2020).

The questionnaires in this study aim to obtain students' responses regarding using multimedia learning based on the scientific literacy of ecosystems. Students' responses are in the form of feedback on the development and use of web-based learning multimedia in classroom learning. Student questionnaires are given after classroom learning using web-based multimedia. Student responses to this learning multimedia are about the content of scientific literacy, potential for increasing learning motivation, and ease of multimedia operation. Table 4 shows the student response questionnaire analysis related to scientific literacy content in multimedia learning.

Table 4. Student Responses to Web-Based Learning Multimedia

No.	Rated aspect	Ideal score	Average		Category
			Score	Percentage	
1.	Contents of Science Literacy in Learning Multimedia	140	124.67	89.05	Very good
2.	The Potential of Multimedia in Increasing Learning Motivation	140	135	96.43	Very good
3.	Ease of Operation of Learning Multimedia	140	123.3	88,10	Very good

The results of student responses provide a very good assessment of web-based learning multimedia. The material in multimedia already contains scientific literacy, which is the goal of this research. The questions presented have also been adapted to the grid that has been created. Furthermore, these results indicate that multimedia can increase students' learning motivation. Students can operate the learning web well. The results of this study align with Soimah (2018) that the use of computer-based technology in the teaching and learning process can increase students' motivation. Multimedia provides a new basis for the teaching and learning process. The most productive teaching and learning approach are to increase motivation, which supports student learning success (Kosasi, 2015).

CONCLUSION

Developing a learning web is one strategy for creating meaningful learning activities. With learning web, learning activities feel more exciting and compelling. Based on the research and data analysis results, the increase in learning outcomes is calculated using the N-Gain Test in the medium criteria. The medium gain value indicates a positive direction difference between learning outcomes before and after learning activities. Based on the responses of students and teachers to learning web in general, they gave a positive and supportive response to its development and use.

REFERENCE

- Ardianto, D., & Rubini, B. (2016). Science Literacy and Student Activities in Integrated Science Learning with Shared Type. *USEJ - Unnes Science Education Journal*, 5(1), 1167–1174.
- Chandra, T., & Royanto, LRM (2019). The Effect of Math Self-Efficacy and Math Anxiety on Mathematical Performance in Fifth Grade Elementary School Students. *Analytica*, 11(2), 126. <https://doi.org/10.31289/analitika.v11i2.2878>
- Fernando, A. (2022). Photostock Design and Implementation at Immanuel Christian High School Batam Using the 4D Method (Define, Design, Develop, Disseminate). *Progressive Community Service Journal*, 6(September), 1271–1275.
- Fitri, F., & Ardipal, A. (2021). Development of Learning Videos Using the Kinemaster Application on Thematic Learning in Elementary Schools. *Journal of Basicedu*, 5(6), 6330–6338. <https://doi.org/10.31004/basicedu.v5i6.1387>
- Fuadi, H., Robbia, AZ, Jamaluddin, J., & Jufri, AW (2020). Analysis of the Causes of the Low Science Literacy Ability of Students. *Scientific Journal of the Educational Profession*, 5(2), 108–116. <https://doi.org/10.29303/jipp.v5i2.122>
- Gani, AG (2016). e-Learning as the Role of Information Technology in Education Modernization. *Suryadarma University Information Systems Journal*, 3(1), 1–19. <https://doi.org/10.35968/jsi.v3i1.52>
- Hardjo, Fanny Nadia. Permanasari, Anna. Permana, I. (2018). Development of Project-Based Teaching Materials on Energy Materials to Improve Students' Science Literacy. *Journal of Science Education And Practice*, 2(1), 27–43.
- Hasan, MMD (2021). Learning Media. The Media Group Throne.
- Husein, SHG (2015). The Effect of Using Interactive Learning Multimedia on Results. *Journal of Informatics Engineering*, II(2), 136–142.
- Ilmiani, AM, Ahmadi, A., Rahman, NF, & Rahmah, Y. (2020). Interactive Multimedia to Overcome the Problems of Learning Arabic. *Al-Ta'rib: Scientific Journal of Arabic Language Education Study Program IAIN Palangka Raya*, 8(1), 17–32. <https://doi.org/10.23971/altarib.v8i1.1902>
- Juniati, N., Jufri, AW, & Yamin, M. (2020). The Use of Learning Multimedia to Improve Students' Scientific Literacy. *Mipa Incandescent Journal*, 15(4), 312–316. <https://doi.org/10.29303/jpm.v15i4.1975>
- Kimberly, Lawless. Scott, Brown. Christopher, Rhoads. Lisa, L. (2018). Promoting Student's Science Literacy Skills Through a Simulation of International Negotiations: The GlobalEd 2 Project. *Computers in Human Behavior*, 78, 389–396.
- Kosasi, S. (2015). Designing E-learning to Improve Teacher and Student Learning Motivation. *Journal of Informatics*, 0362, 27213.

<http://pti.undiksha.ac.id/senapati>

- Latip, A., & Permanasari, A. (2016). Multimedia Development of Science Literacy-Based Learning for Junior High School Students on the Theme of Technology. *Education*, 7(2). <https://doi.org/10.15408/es.v7i2.1761>
- Martinah, AA, Mubarak, V., Miarsyah, M., & Ristanto, RH (2022). Development of Contextual-Based Science Literacy Test Instruments on Environmental Pollution Materials. *Bioedusiana: Journal of Biological Education*, 6(2), 192–218. <https://doi.org/10.37058/bioed.v6i2.3251>
- Pratiwi, SN, Cari, C., & Aminah, NS (2019). 21st Century Science Learning with Student Science Literacy. *Journal of Physics Materials and Learning*, 9, 34–42.
- Priyambodo, E., Wiyarsi, A., & Sari, RLP (2012). The Influence of Web-Based Interactive Learning Media on Students' Learning Motivation. *Journal of Education: Learning Innovation Research*, 42(2), 99–109.
- Purmadi, A., & Surjono, HD (2016). Development of Web-Based Teaching Materials Based on Student Learning Styles for Physics Subjects. *Journal of Educational Technology Innovation*, 3(2), 151. <https://doi.org/10.21831/jitp.v3i2.8285>
- Rubini, B., Ardianto, D., Pursitasari, ID, & Permana, I. (2016). Identify scientific literacy from the science teachers' perspective. *Indonesian Journal of Science Education*, 5(2), 299–303. <https://doi.org/10.15294/jpii.v5i2.7689>
- Seprianto. (2020). The Relationship between Understanding the Basic Concepts of Chemistry and Students' Scientific Literacy Ability. *CATALYST: Journal of Chemical Research and Chemistry Education*, 3(1), 17–23.
- Septian, D. (2018). Science Learning with Interactive Multimedia Assisted Learning Cycle in terms of Initial Knowledge and Student Learning Styles. *Journal of Physics and Science Education (JPFS)*, 1(1), 1–13.
- Shalikhah, ND (2017). Lectora Inspire Interactive Learning Media as Learning Innovation. *LPM News*, 20(1), 9–16. <https://doi.org/10.23917/warta.v19i3.2842>
- Soimah, I. (2018). The Effect of Computer-Based Learning Media on Science Learning Outcomes in terms of Student Learning Motivation. *Natural: Scientific Journal of Science Education*, 5(1), 38. <https://doi.org/10.30738/natural.v5i1.2559>
- Sukowati, D., & Rusilowati, A. (2016). Analysis of Students' Science Literacy And Metacognitive Ability. *Physics Communication*, 1(1), 16–22.
- Yuliasih, FS (2022). 21st Century Skills-Based Assessment Instrument to Measure Science Literacy Ability of High School Students. *Unnes Physics Education Journal*, 3(3), 77–83.

- Yuliati, Y. (2017). Science Literacy in Science Learning. *Journal of Pendas Cakrawala*, 3(2), 21–28. <https://doi.org/10.31949/jcp.v3i2.592>
- Yuningsih, Winda. Permanasari, Anna. Permana, I. (2020). Multimedia Development of Science Learning Based On Science Literacy on The Theme of Lightning. *Journal of Science Education And Practice*, 4(2010), 69–84.