Web-assisted living diversity digital teaching materials to improve students' science literacy and environmental attitudes

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Abstract: The 21st century skills measured at Senior High School 9 Malang are communication, collaboration, critical thinking, and creativity, while science literacy and environmental attitudes have never been measured before. This study aims to improve students' science literacy and environmental attitudes in a valid, practical, and effective way. The research and development model refers to Lee and Owens, which was implemented in Grade X Senior High School 9 Malang with a sample size of 34 people. The developed teaching materials were tested for validity, practicality, and effectiveness. In addition to expert validation tests, empirical validity tests were also carried out using Pearson product moment and reliability using Cronbach's alpha. The results obtained from the development of web-assisted digital teaching materials on the diversity of living things are valid, practical, and effective. The empirical validity value using Pearson's product moment obtained significance <0.05, so that the valid criteria were obtained, and the reliability value of Cronbach's alpha obtained 775 reliable categories. The effectiveness test results using N-gain obtained a value of 0.43 in the moderate category.

1. Introduction

Education in Indonesia uses the Merdeka Curriculum. The application of this is flexible according to student characteristics and school conditions. The Ministry of Education and Culture revealed in 2022 that the learning system refers to student learning outcomes (teaching at the right level). Ramadina (2021) states that the essence of this curriculum is to create a student-centered learning process. Kemendikbudristek BSKAP (2022) merdeka curriculum is based on competence, more flexible learning, and Pancasila character. Education is an important pillar in building social character in the millennial era (Akhsania, 2018).

The Merdeka Curriculum emphasizes the learning process for 21st-century life skills. 21st century learning applies creativity, critical thinking, cooperation, problem solving, communication skills, community, and character skills (Mardhiyah et al., 2021). 21st century learning is learning that combines literacy, knowledge and competency skills, skills and attitudes, and mastery of technology (Indarta et al., 2021). This is also supported by Kemendikbudristek BSKAP (Badan Standar Kurikulum and Asesment Pendidikan) (2022) based on learning outcomes in the Natural and Social Science Project, which consist of three competency elements that refer to scientific literacy competencies: explaining phenomena scientifically, designing and evaluating scientific investigations, and interpreting data and evidence scientifically. So that literacy is currently needed, one of which is the application of scientific literacy.

Science literacy is a basic skill related to curiosity and student independence in learning (Putri et al., 2020). Science literacy is a skill that must be possessed by someone because it is needed in everyday life to think logically and rationally. According to Majima (2015), someone who has good science literacy will not think irrationally. This is also supported by the opinion of Sharon (2020) that individuals who have an awareness of science can recognize relevant science sources, enrich their understanding of their own

lives, and connect knowledge and information gained from personal experience. Gormally et al., (2012) define science literacy as the ability to use evidence and data to evaluate the quality of science information and arguments. According to Gormally et al., (2012), indicators of science literacy are: 1) identifying valid scientific arguments; 2) evaluating the validity of sources; 3) evaluating the use and misuse of scientific information; 4) understanding the elements and how they affect scientific findings or conclusions; 5) making appropriate graphic representations based on data; 6) reading and interpreting graphic representations of data; 7) solving problems using quantitative inferences, including basic statistics; 8) understanding and interpreting basic statistics; and 9) making inferences, predictions, and conclusions based on quantitative data.

The results of a study conducted by the Language Development and Development Agency in 2018 conducted in 34 provinces and involving grade X students showed that most of the students tested (37.5%) showed reading competence at level 3, namely answering simple questions from discourse with moderate complexity, as well as making low-level inferences such as discourse genres, knowing certain definitions in some parts of the discourse, and using general knowledge for those related to understanding discourse (Dewayani et al., 2021). The application of science literacy can affect a person's environmental attitude. This is because science literacy and environmental attitudes are two things that are interrelated.

Environmental attitudes are psychological tendencies that are expressed by evaluating the natural environment with some level of like or dislike (Milfont & Duckitt, 2010). The environmental attitude indicators used are adaptations of Milfont and Duckitt, (2010), with seven indicators including: 1) environmental movement activism; 2) conservation motivation; 3) environmental fragility; 4) altering nature; 5) personal conservation behavior; 6) human utilization of nature; and 7) ecocentric concern. Science literacy and environmental attitudes are two things that are interrelated and play an important role in maintaining environmental stability. Research by Amin *et al.*, (2020) shows that the environmental attitudes of social studies education study program students at UIN Maulana Malik Ibrahim Malang are low, as evidenced by the lack of concern for the condition of the campus environment and dirty classrooms because they consider cleaning up garbage to be a cleaning service task. Handayani et al., (2022) revealed that the high value of environmental knowledge will have an impact on the behavior of loving or caring for the environment. Low environmental attitudes are certainly not only influenced by knowledge but can also be influenced by the social environment. Wang, (2017) reveals that the environmental attitude of an individual or a person is positively related to behavior, especially in the environment where the individual is located.

The results of observations and interviews at Senior High School 9 Malang show that the curriculum used is the Merdeka Curriculum, teaching materials need to be made because in terms of practicality it is very necessary and in accordance with students' learning habits, web-assisted digital teaching materials have never been applied before, web-assisted digital teaching materials are needed to support the learning process to increase broader knowledge, learning resources used by students in the form of learners' worksheet, Kahoot, Quizziz, Google form, Power Point, practicum instructions, the use of learning media is more likely to free students to find information such as students using power point, digital modules/books, YouTube videos, posters, etc.

The use of learning media is more likely to free students to find information. The 21st century life skills that have been applied at Senior High School 9 Malang are critical thinking, creativity, communication, and collaboration skills, while science literacy skills and environmental attitudes have never been developed. Then the results of questionnaires related to the preliminary study given to students showed 92% already knew web-assisted digital teaching materials, but students' knowledge of web-assisted digital teaching materials was still inaccurate because students assumed that this digital teaching material was like a handout or game-based learning integrated through the web.

Teaching materials used by teachers on average are learners' worksheet, Kahoot, Quizlet, Google Form, digital books and handouts, Power Point, and YouTube. 56.4% of students answered related to learning media used by teachers in the form of power point and 7.3% in the form of pictures to explain the material. Web-assisted digital teaching materials have never been applied, science literacy has never been measured, and students' environmental attitudes are still low.

The learning model that is often used is PBL, so researchers try to apply learning with web-assisted digital teaching materials using guided inquiry models. Guided inquiry is a learning method that can encourage students to learn actively to find a concept in the learning process in which the teacher provides clear guidance or instructions (Zulfikar et al., 2019). In this case, it can be concluded that guided inquiry can train or facilitate students' science literacy because it encourages students to learn actively to find out the truth of a concept. From the explanation that has been given, researchers want to create innovations to package the material to make it more interesting and to train students' science literacy and environmental attitudes. The purpose of developing digital teaching materials for the diversity of living things is to determine their validity, practicality, and effectiveness in increasing students' science literacy and environmental attitudes.

2. Materials and Methods

The developed teaching materials were tested for validity, practicality, and effectiveness. The development model refers to Lee and Owens, which is procedural in nature because each stage is structured, coherent, and clear. The development stages of Lee and Owens consist of 4 stages, including: 1. assessment and analysis, which consists of need assessment and front-end analysis; 2. design; 3. development and implementation; and 4. evaluation, as seen in Figure 1.

The substance of the material is explored in the Malabar City Forest with the exploration method. The research design for effectiveness used a pre-experimental design with a non-randomized pretest-posttest control group type. The research was conducted in Class X Senior High School 9 Malang with a sample size of 34 students. Data collection instruments of web-assisted digital teaching materials development research through interviews, questionnaires, observations, and tests. Qualitative data analysis of the development of web-assisted digital teaching materials for the diversity of living things was obtained through a validation questionnaire of material experts, media practitioners, and field practitioners. The criteria for the validity of web-assisted digital teaching materials for the diversity of living things can be seen with the Formula 1, description: P is percentage, TSH is total expected score, TSe is total empirical score. The results of the data analysis obtained are then interpreted with reference to Table 1.

$$P = TSe/TSh \times 100\% \tag{1}$$

Table 1. Criteria and Level of Product Validity of Web-assisted Digital Teaching Materials for Diversity of Living Things

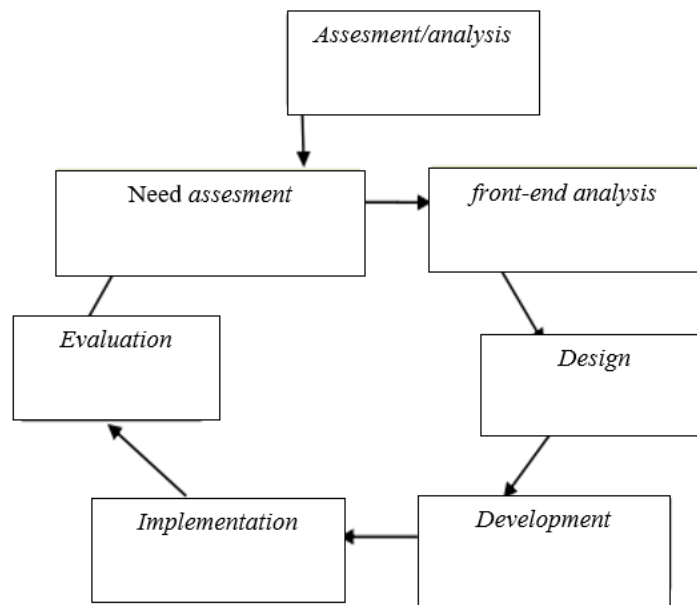| Validity	Criteria Validity Level
100%	Very valid
85.01-99.00%	Valid with minor revisions
70.01-85.00%	Moderately valid, with a major revision
50.01-70.00%	Less valid, major revision
01.00-50.00%	Not valid; total revision

Source: Adaptation of Akbar (2013)

Figure 1. Research and Development Procedure (Source: Lee & Owens, 2004)

Quantitative data obtained from the results of the effectiveness test of web-assisted digital teaching materials for the diversity of living things measured by N-gain. Instrument validity is measured empirically through instrument validity using Pearson product moment and reliability using Cronbach's α with SPSS.

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3. Results

The results of the validation test of web-assisted digital teaching materials for the diversity of living things are described in Table 2. The practicality of web-assisted digital teaching materials for the diversity of living things obtained a score of 90.03% with practical criteria. Assessment of the effectiveness of pre-experimental design type non-randomised pretest-posttest control group science literacy obtained a score of 0.43, and the effectiveness value of attitude obtained a score of 0.39 in the medium category.

Table 2. Results of Validation of Web-assisted Digital Teaching Materials for Diversity of Living Things

No	Validation	Score	Criteria
1	Material	100	Very valid
2	Instrument	96,83	Valid
3	Media	98.56	Valid
4	Field Practitioner	97,9	Valid

4. Discussion

Digital teaching materials for web-assisted Diversity of Living Things can be seen in Figure 2, and the substance of the material developed through exploring the Malabar City Forest in Malang, in the form of animalia and plantae, including taxonomy, description, role, and IUCN conservation status, as well as descriptions of the species found. The display of teaching materials consists of a cover, logo, moving animation, navigation buttons, including information in the form of Malabar City Forest videos, instructions for use, a quiz, plant and animal material, a glossary, and a bibliography.
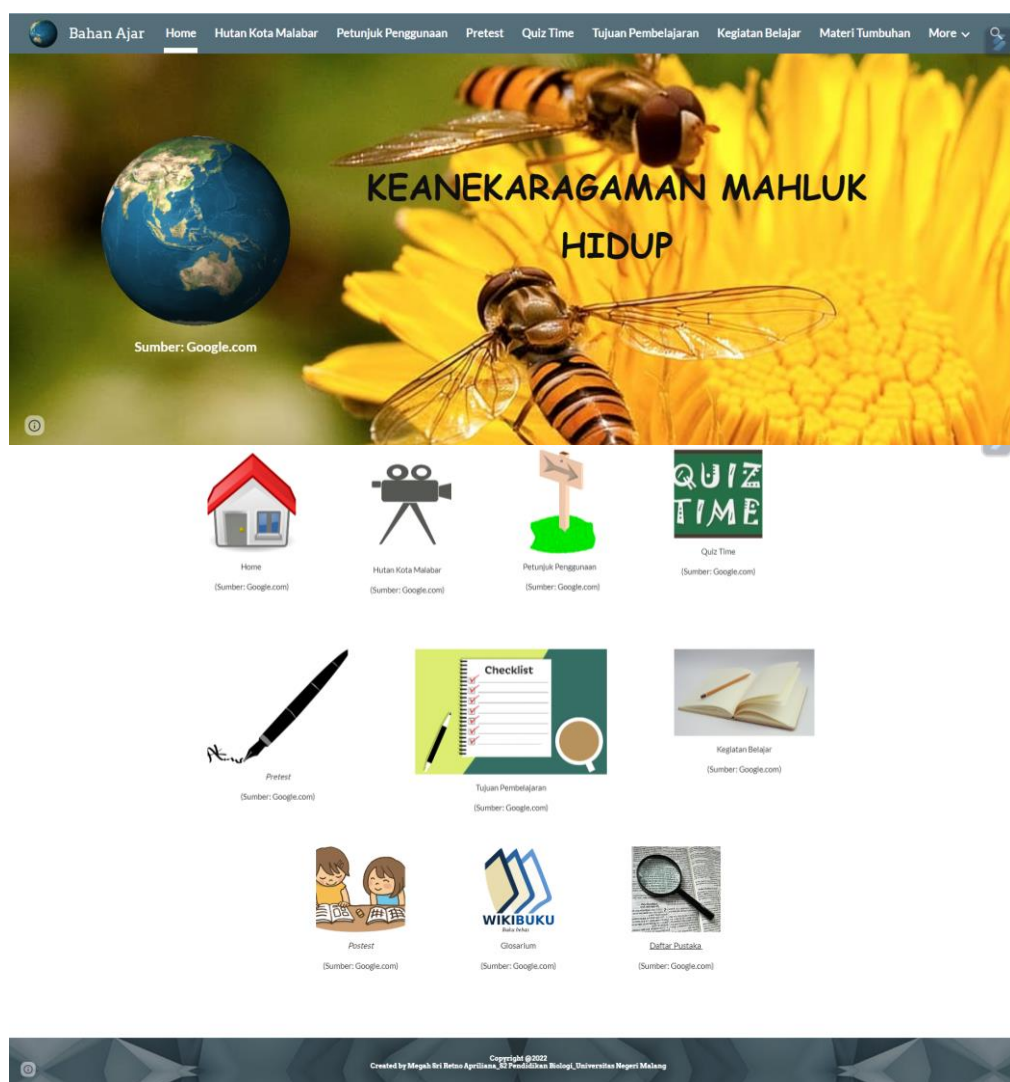
Figure 2. Web-assisted digital teaching materials for the diversity of living things

The results of the validation test of web-assisted digital teaching materials for material validation showed a score of 100 with very valid criteria. Referring to the validity table adapted from Akbar (2013) a score of 85.01–99.0% is valid, and a score of 100% is very valid. The material must be 100% correct because it affects the content of the material to be taught. Incorrect mastery of teaching materials will have an impact on misconceptions. According to Rokhim et al., (2023), the occurrence of misconceptions can be stored in the cognitive structure of students for a long time and affect the construction of knowledge on the next concept.

The results of instrument validation obtained a score of 96.83 for valid criteria. Akbar (2013) values of 85.01–99.00% are included in the valid category. This validation is intended to ensure that the instrument that has been made is feasible to use and does measure what is to be measured (Ernawati, 2017). Measurements of science literacy and environmental attitudes were empirically tested using Pearson product moment and reliability using Croncbach's alpha through SPSS. The value of scientific literacy and environmental attitudes using Pearson product moment correlation obtained a significance value of <0.05, including the valid category. The smaller the significance value, the more valid the test. Criteria for validity: according to Nunnally and Bernstein, (1994), if the value of rtable> rcount with α = 0.05, then the instrument is valid. The calculation of the reliability of cognitive learning outcomes refers to the indicators of science literacy, which obtained a score of.775 while the reliability of the environmental attitude

questionnaire sheet obtained a score of.730, including the reliable category. Reliability criteria: according to Nunnally and Bernstein, (1994), if α≥ 0.60, then the instrument is declared reliable.

The media validation value obtained a score of 98.56%, a valid category. Akbar (2013) product criteria with a value of 85.01–99.00% are valid. The validation results show that the web-assisted digital teaching materials for the diversity of living things are feasible to use. The feasibility of web-assisted digital teaching materials for the diversity of living things is seen in terms of appearance and flexibility when used. Jannah and Suciptaningsih, (2023) argue that flexible learning is needed to support student activities in the Merdeka Curriculum. Farikhin et al., (2022) argue that the flexibility of teaching materials makes it easy for students to access and obtain the learning materials needed so that they can carry out the learning process anytime and anywhere.

The validation value by biology education practitioners obtained a score of 97.9%, a worthy category. Akbar (2013) says the value of 85.01–99.00% is valid. The validation results show that digital teaching materials for the diversity of living things assisted by the web are feasible to use. The feasibility of digital teaching materials for the diversity of living things is seen in terms of contextuality in learning. Ramdani (2018) contextualized activities provide direct experience to students by playing an active role in learning activities. Wahyuni and Rahayu, (2021) learning activities related to daily life will make students understand the material faster and easier.

The practicality value of web-assisted digital teaching materials for the diversity of living things obtained a score of 90.03%, based on practical criteria. The criteria for practicality adapted from Akbar (2013) show a score of 85.01–99.00%, including the practical category. The score of 90.03% is because the learning activities are always repeated for six meetings, even with different materials. Practicality is moderate because learning activities are quite boring and the writing has too many colors. Students showed less interest in reading activities, tended to be individualistic, and lacked compromise in group discussion activities. Web-assisted digital teaching materials for the diversity of living things should be able to trigger student motivation for learning. Research by Fernando et al., (2022) shows that web-based digital teaching materials are very feasible and practical to use to assist in the learning process. The use of digital teaching materials can help students broaden their horizons. Husniati et al., (2022) found that web-based e-learning media is practical and can provide new insights for students.

Assessment of the effectiveness of a pre-experimental design with a non-randomised pretest-posttest control group type of science literacy obtained a score of 0.43, medium criteria, with a percentage increase in science literacy skills of 29%. The moderate criteria obtained were influenced by several factors, including students' lack of interest in looking for clues or instructions, reading articles, and, when in groups, being less active in discussing. Science literacy is one of the skills that is very important for everyone to have. Safrizal et al., (2022) revealed that science literacy is increasingly seen as a goal that must be pursued by the school system because it plays an important role in producing and shaping students who have the ability to think logically, creatively, innovatively, and globally competitively. Gormally et al., (2012) define science literacy as the ability to use evidence and data to evaluate the quality of science information and arguments. Wahyu et al., (2020) argue that science literacy is very important to be prepared for because everyone needs information in everyday life as a reference to think scientifically in making decisions and solving problems.

The assessment of the effectiveness of environmental attitudes with a pre-experimental design type of non-randomised pretest-posttest control group obtained a value of 0.39 in the medium category Hake (1999) $0.3 \leq$ n-gain < 0.7 is in the moderate category, with a percentage increase in environmental attitudes of 19%. The moderate criteria obtained, because students show less interest in learning, means that when working on learners' worksheet, students must be stimulated first. In group discussions,

only a few students are active, while other members tend to be passive and wait for instructions. Palupi and Sawitri, (2017) argue that human attitudes and behaviors will determine the good and bad conditions of an environment. Milfont and Duckitt, (2010) revealed that environmental attitude is an important construct in building environmental psychology. The results obtained between science literacy and environmental attitudes show a correlation or relationship, indicating that both are closely related. Khozin et al., (2020) revealed that there is a positive correlation between learning outcomes and environmental care attitudes. Qomariyah et al., (2019) found that the implementation of learning using modules can increase the average post-test scores of science literacy and environmental care attitudes on biodiversity material.

5. Conclusion

Based on the results of the study, it is concluded that the web-assisted digital teaching materials for the diversity of living things are valid, practical, and effective for improving students' science literacy and environmental attitudes. This is evidenced by the material content validation value, which obtained a score of 100% in the very valid category; the instrument validation value, which obtained a score of 96.83%; the media validation value, which obtained a score of 98.56%; and the validity of field practitioners, which obtained a score of 97.9 with valid criteria. Practicality value obtained a score of 90.03%, practical criteria. The effectiveness value of science literacy obtained a score of 0.43, and environmental attitudes obtained a score of 0.39, with moderate effectiveness criteria.

Conflicts of Interest: Authors declare that there are no conflicts of interest.

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