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# Science Digital Library: Innovation in Improving Science Literacy of Elementary School Students

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**Abstract**: The results of the initial study conducted at Sidoharjo 1 Elementary School found problems that caused the low science literacy of grade VI students. These problems include inappropriate teaching materials, less contextualized science learning, inadequate science learning media, and a lack of motivation for students to learn science. The purpose of this research is to develop a Science Digital Library that can improve science literacy. The method used in this research is the research and development of the ADDIE model with the stages of Analyze, Design, Develop, Implement, and Evaluate. The research subjects were 21 sixth-grade students of Sidoharjo 1 Elementary School. Data collection techniques are media and material expert validation, student response questionnaires, and tests. The results of the study were that media experts and material experts validated the Science Digital Library. The results of the media validation were 88% with very valid qualifications, while the material validation was 92% with very valid qualifications. Science literacy assessment instruments measure science literacy skills. The improvement was calculated by the normalized gain formula (g) with the result of 0.71. The result of this study is that the Science Digital Library is proven to be feasible and valid for use and can improve science literacy in grade VI students of Sidoharjo I Elementary School.
**Keywords:** science digital library, scientific literacy, natural science

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## Introduction

Low science literacy skills are one of the problems of education in Indonesia. Students' science literacy is not necessarily well-trained. Data on the achievement of science literacy of Indonesian students in the PISA science literacy assessment evidence this. During the three PISA science literacy assessments in 2006, 2009, and 2012, the average achievement of students' science literacy scores was still in the range of 382-395. This means that the science literacy skills of Indonesian students are still low compared to the average science literacy skills of students from other countries (Yusmar & Fadilah, 2023). The PISA results obtained by Indonesia in 2022 showed a decrease compared to 2018 in the fields of math, reading, and science. The average science achievement of 15-year-olds was 383 points, compared to an average of 485 points in OECD countries (Kemendikbudristek, 2023).

Based on the results of observations made by researchers on grade VI students of Sidoharjo 1 Elementary School, Tuban Regency, it was found that the science learning carried out had not led to the development of students' science literacy. In delivering learning, teachers use learning media that are less appropriate and less innovative. Science learning is less contextual and relevant to everyday life. Teachers have not optimized digital technology learning media. Teachers also do not carry out learning by utilizing media that presents scientific phenomena, so students seem to have difficulty in linking the concepts learned with phenomena that occur in everyday life. The utilization of digital-based learning media is only limited to transferring teaching materials to digital media.

This causes learning to be less than optimal, so students' understanding of science literacy is still poor. Therefore, innovation is needed so that learning becomes more interesting and can build learning

motivation. According to Jainiyah et al. (2023), students who have learning motivation will be successful during the learning process. Therefore, teachers must optimally foster students' learning motivation. Teacher creativity is needed to foster students' learning motivation.

The findings above indicate that the learning process at Sidoharjo 1 Elementary School, Tuban Regency, is not optimal in facilitating students' science literacy. Based on these problems, a solution is needed so that science learning can train students' science literacy. Indonesian students are expected to have good science literacy in an effort to prepare science-literate human resources and citizens.

The results of observations made at Sidoharjo 1 Elementary School show that most students already have smartphones that can be utilized for positive activities, namely as learning tools in the classroom. In addition, the school also has a sufficient number of Chromebook facilities to use in classroom learning. The mapping of assets owned by this school is the basis for the development of the Science Digital Library. The library is expected to improve children's science literacy.

Previous research has found learning innovations to improve students' science literacy. One of them is previous research conducted by Habibillah et al. (2022), which explained that the digital library provides access to digital books so that they can be accessed anytime and anywhere, thus supporting the needs of Generation Z. In addition, the digital library also helps students get digital books easily, so it is expected to support their independent learning process. In addition, the digital library also helps students get digital books easily, so it is expected to support the independent student learning process. Research on Efforts to Improve Students' Science Literacy through Computer-Based Science Learning Media conducted by Latif & Faisal (2021) concluded that the form of computer-based learning media used in science learning to improve science literacy consists of various forms, namely learning multimedia, interactive E-books, E-modules, animated videos, and android-based media. In addition, the use of computer-based media in science learning has an impact on improving students' science literacy skills. The results show that computer-based media can be developed in various forms and play a role in improving students' science literacy in science learning.

There is still little research and development on the Science Digital Library in Indonesia, especially at the elementary school level. Therefore, it is necessary to develop a new product in the form of a Science Digital Library. The novelty aspect of this research is that the collection of this digital library is not limited to electronic documents as a substitute for printed forms; electronic books in digital libraries are equipped with audio media that are not owned by electronic books in general. Based on this description, researchers developed a learning innovation in the form of a Science Digital Library that can improve science literacy in grade VI students of Sidoharjo 1 Elementary School.

## Methods

This research was a type of development research or Research and Development (R&D) using the ADDIE model development method (Analyze, Design, Development, Implementation, Evaluation), which aims to develop a Science Digital Library in learning science on the topic of plant reproduction and to determine the increase in science literacy in grade VI elementary school students. The ADDIE model development research procedure can be seen in Figure 1.

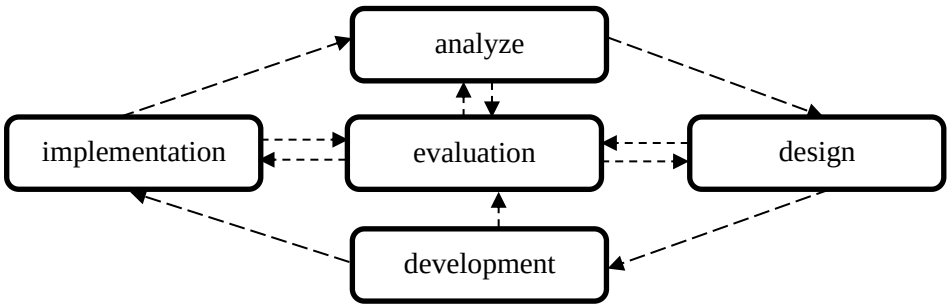


**Figure 1.** Stages of the ADDIE Model

The subjects of this study were one media expert, one material expert, and 21 sixth-grade students at Sidoharjo 1 Elementary School, Tuban Regency. Data collection instruments used observation sheets

on science learning of Plant Breeding material, interview guidelines, documents, media validation questionnaires, material validation questionnaires, student response questionnaires, and tests.

In the analysis of Digital Library development, data was obtained from the results of the validation questionnaire of material experts and media experts with five answer options in the form of a checklist. This material validation instrument was developed from the Learning Object Review Instrument (LORI) version 2.0 (Nesbit et al., 2009). Indicators of questions on the material validation instrument include (1) content quality which includes the accuracy of the material, the accuracy of the material, the organization of the presentation of the material, and the accuracy in placing material level details; (2) learning (learning goal alignment) which includes compatibility with learning objectives, compatibility with learning activities, compatibility with assessment in learning, and compatibility with student characters; (3) different learners or learning models can drive feedback and adaptation which includes adaptation content or feedback; and (4) motivation which includes the ability to motivate and attract the attention of many learners. The indicators of questions on the media validation instrument include: (1) presentation design, namely multimedia design, is able to assist in improving and streamlining learning; (2) interaction usability, namely ease of navigation and predictable appearance; (3) accessibility, namely ease of access; and (4) reusability, namely the ability to be used in various variations of learning and with different students.

The following are the criteria for analyzing the material and media validation questionnaires according to the Likert scale in Table 1.

**Table 1.** Likert Scale Criteria

| Criteria | Score | Formula |
|---|---|---|
| Very Good | 5 | (P) = $\frac{score\ obtained}{ideal\ maximum\ score}\ x\ 100\%$ |
| Good | 4 | |
| Simply | 3 | |
| Less | 2 | |
| Very Less | 1 | |

The data generated from the validation questionnaire will be analyzed using a rating scale. With a rating scale, the data obtained in the form of numbers is then interpreted in a qualitative sense. In the rating scale model, respondents will not answer one of the qualitative answers provided, but answer one of the quantitative answers provided. The questionnaire will be processed in two ways, namely calculating the percentage of answers from each question item and calculating the average answer based on the scoring of each answer from the respondent.

The learner response questionnaire was used to obtain data on the practicality of the developed Science Digital Library. Indicators of learner response questionnaire, namely: (1) initial appearance of the Science Digital Library; (2) ease of starting the Science Digital Library; (3) appropriateness of fonts in the Science Digital Library; (4) display of images contained in the Science Digital Library; (5) language used in the Science Digital Library; (6) ease of navigation in the operation of the Science Digital Library; (7) ease of accessing flipbooks in the Science Digital Library; (8) understanding of material after using the Science Digital Library; (9) learning independence with the help of the Science Digital Library; and (10) interest in learning using the Science Digital Library. The following are the criteria for analyzing the modified learner response questionnaire based on the needs of the results measured according to the Likert scale criteria in Table 2.

**Table 2.** Likert Scale Criteria for the Learner Response Questionnaire

| Criteria | Score | Formula |
|---|---|---|
| Strongly Agree | 5 | (P) = $\frac{score\ obtained}{ideal\ maximum\ score}\ x\ 100\%$ |
| Agree | 4 | |
| Disagree Less | 3 | |
| Disagree | 2 | |
| Strongly Disagree | 1 | |

The test instrument was used to determine science literacy before and after learning with the Digital Library. The lattice of science literacy instruments is presented in Table 3.

**Table 3.** Lattice of Science Literacy Instrument

| Dimensions or Aspects of Science Literacy | Science Literacy Indicators | Question Number |
|---|---|---|
| **Competency Aspects/ Science process** It is a person's process of answering a question or solving a scientific problem. | 1. Identify scientific issues or questions<br>2. Explaining phenomena scientifically<br>3. Using scientific evidence | 1, 2, 3 |
| **Knowledge Aspect/ Science Content** It is a situation that has to do with the application of science in everyday life, which is used as material for the application of the process and understanding of science concepts. | 1. Content Knowledge<br>2. Epistemic Knowledge | 4, 5, 6 |
| **Science Content Aspects** It is a situation that has to do with the application of science in everyday life, which is used as material for the application of science processes and understanding of science concepts. | 1. Health Sector<br>2. Natural Resources<br>3. Environmental Quality<br>4. Danger | 7, 8, 9, 10 |
| **Scientific Attitude** It is attitudes toward science play an important role in learners' decisions to develop science knowledge further, pursue careers in science, and use scientific concepts and methods in their lives. | 1. Curiosity<br>2. Applicative ability<br>3. Scientific and critical thinking skills<br>4. Independence<br>5. Development of a caring and responsible attitude towards the natural and social environment | 11, 12, 13, 14, 15 |

The improvement of science literacy can be known by using tests. The test used was a multiple choice test of 15 items. The data analysis technique used an n-gain score. The gain score value illustrates the improvement of science literacy after using the Digital Library. The normalized n-gain score formula can be seen as follows.

$$g = \frac{posttest\ score - pretest\ score}{maksimum\ score - \ pretest\ score}$$

Based on the results of the calculation of the gain score value, it can then be interpreted into the value (g) in Table 4.

**Table 4.** Gain Score Interpretation (Hestiana & Rosana, 2020)

| Elementary School | Elementary School |
|---|---|
| g < 0.3 | Low |
| 0.7 > g > 0.3 | Medium |
| g > 0.7 | High |

## Results and Discussion

### Science Digital Library Development

The Science Digital Library development research uses the ADDIE model, which consists of five stages, namely Analyze, Design, Development, Implementation, and Evaluation. The following is a description of the stages of developing the Science Digital Library as an innovation in improving the science literacy of elementary school students.

**Analyze**

At the analysis stage, researchers analyzed the needs of students based on curriculum analysis, material analysis, and analysis of student characteristics. In addition, it also analyzes the need for learning media development and the feasibility of developing new learning media. Previously, researchers conducted a document study on the curriculum of Natural Science subjects at Sidoharjo 1 Elementary School, Senori District, Tuban Regency, by conducting interviews with teachers and students and making observations on Natural Science learning in the classroom. The results of document analysis conducted by researchers on curriculum documents found data on Basic Competencies in Natural Science subjects, namely Basic Competency 3.1 Comparing the ways of plant and animal reproduction and Basic Competency 4.1 Presenting work on plant reproduction.

The interview was conducted by the researcher with the teacher of Sidoharjo 1 Elementary School. The interview procedure was carried out through several stages, namely: (1) determining the purpose of the interview; (2) determining indicators; (3) making interview grids; (4) determining targets/respondents; (5) developing question items, (6) expert validation; and 7) conducting interviews. After conducting interviews, researchers found that students have difficulty in learning science; not all learning media used can improve science literacy skills. Teachers need digital learning media that can train science literacy skills on Plant Breeding material and can attract students' interest in learning at school. In addition, the pretest scores of students on Plant Breeding material showed that 71% of students had scores below the minimum completeness criteria.

The study describes the results of research and development of a Digital Library. The Digital Library developed by Nopitasasi et al. (2024) only contains digital books of fable stories. The content in the Digital Library is not complete, especially digital teaching materials that can be used for science learning. The research subjects were 23 fifth-grade students in elementary schools in Sumedang Regency, West Java Province. The research method used was Design and Development (D&D). The results of the study, namely the Digital Library of Fable Stories (PDCF), received a score of 97.14%, which is worthy of being used as a medium for learning Indonesian in elementary schools.

Based on previous research and development of Digital Libraries, researchers found novelty in the research and development that will be carried out. The novelty of the research and development to be carried out lies in the content in the Digital Library. Previous research only focused on teaching materials for fable stories in Indonesian language subjects, while the Digital Library to be developed focuses on Digital Libraries to facilitate students in science learning and improve science literacy.

Researchers developed a Science Digital Library that can be used on computers, laptops, or smartphones. The use of computer-based media and the ease and frequency of accessing information via the internet are predictors of science literacy skills. The use of computer-based media in science learning is an important part that needs to be developed to have a positive impact on improving students' science literacy skills. The Science Digital Library is able to integrate sound, text, images, graphics, visuals, and music impressions so that the information conveyed is richer than conventional learning media.

**Design**

The second stage in the development of this ADDIE model is design, which is the planning stage of the Science Digital Library and the collection of materials needed in the development of the Science Digital Library. The first step taken at the design or planning stage is to determine the indicators of competency achievement based on the curriculum analysis that has been carried out at the analysis stage. The next step is to find references to Plant Breeding material that can achieve the learning objectives that have been determined.

The application for the development of the Science Digital Library is also determined at the design stage. Researchers used the www.anyflip.com application to develop the Science Digital Library. This type of teaching material in the Science Digital Library is designed in the form of a flipbook containing Plant Breeding material. Teaching materials contained in the Science Digital Library are science comics, science stories, science posters, and science infographics. Flipbooks in the Science Digital Library are accessed online via computer, laptop, or smartphone devices. Next, researchers designed the content of the product or Science Digital Library. This step begins with the preparation of Media Content Outline (GBIM), Material Outline (JM), and script (storyboard) (Gofar, 2019).

**Development**

The development stage begins with developing teaching materials in the form of flipbooks that will be uploaded to the Science Digital Library in accordance with the previous planning or design stage. Here, researchers developed twelve (12) flipbooks. Each flipbook consists of topics or learning objectives. The flipbooks developed in this Science Digital Library discuss the material of Plant Breeding, including (1) Bagaimana Jagung Berkembangbiak?; (2) Aku Belajar Mencangkok; (3) *Tunas pada Pisang*; (4) *Bagaimana Cara Wortel Berkembangbiak*?; (5) *Perkembangbiakan pada Bawang Merah*; (6) *Stek Batang Singkong*; (7) *Spora, Perkembangbiakan Vegetatif Alami*; (8*) Kentang, Umbi Akar atau Umbi Batang*?; (9) *Mengenal Tumbuhan yang Berkembangbiak dengan Akar Tinggal*; (10) *Mengenal Geragih atau Stolon*; (11) *Okulasi Durian*; (12) *Menyambung, Perkembangbiakan Vegetatif Buatan*.

The development of flipbooks in this Science Digital Library pays attention to four interconnected dimensions (aspects) of science literacy, namely competence (science process), knowledge or science content, science context, and attitudes (Rini, 2021).


**Figure 2.** Flipbook on Science Digital Library

The next step is to develop a Science Digital Library consisting of bookshelves containing flipbooks. The content in this science library contains readings that can develop and improve science literacy.


**Figure 3.** Science Digital Library

At this stage of development, a validity test is carried out on material experts and media experts to test the Science Digital Library. This validity test intends to obtain criticism and suggestions to find out whether the developed Science Digital Library is feasible or not feasible for use in elementary schools.

The results of validation conducted by material experts show that six (6) indicators get a score of 5 or very good, namely on indicators: (a) The accuracy of the material; (b) The accuracy of the material; (c) The suitability of the learning objectives; (d) The suitability of the assessment in learning; and (e) The content of adaptation or feedback can be driven by students or different learning models; and (f) The ability to motivate and attract the attention of many students. Indicators get a score of 4 or good are four (4) indicators, namely: (a) Organized in Material Presentation; (b) Accuracy in Placing Material Level Details; (c) Suitability with learning activities; and (d) Suitability with student characters.

The results of validation conducted by media experts show that there are two (2) indicators that get a score of 5 or very good, namely multimedia design is able to help improve and streamline learning and the ability to be used in various variations of learning and with different students. While indicators that get a score of 4 or good, namely Ease of navigation, Predictable display, and Ease of access.

**Table 5.** Validation Test Results

| Variables Tested | Percentage | Qualification |
|---|---|---|
| Science Digital Library feasibility validation | 92% | Very Valid |
| Validation of Materials in the Science Digital Library | 88% | Very Valid |

Based on the results of material validation, the quality of the material in the digital library developed can be seen. The results are from 10 frequencies or validation indicators, with a total score of 46, an average of 4.6, and a percentage of 92% with very valid qualifications. In contrast, the results of media validation results, namely from 5 frequencies or validation indicators, getting a total score of 22, with an average of 4.4, and a percentage of 88% with very valid qualifications. So, based on the results of material and media validation, the Science Digital Library is feasible to use in learning Natural Sciences on Plant Breeding material.

**Implementation**

At the implementation stage, the Science Digital Library has been developed. The researcher then asked students to fill out a questionnaire that aimed to determine the students' response to learning with the Science Digital Library. The learner response questionnaire has eleven (10) indicators with five (5) alternative choices, namely Strongly Agree (SS), Agree (S), Disagree Less (KS), Disagree (TS), and Strongly Disagree (STS). The following is Table 6, which contains the results of filling in the response questionnaire sheet of grade VI students of Sidoharjo 1 Elementary School, totalling 21 students learning with the Science Digital Library.

**Table 6.** Results of the Learner Response Questionnaire

| Indicators | Assessment | | | | | Amount |
|---|---|---|---|---|---|---|
| | SS (5) | S (4) | KS (3) | TS (2) | STS (1) | |
| 1. Initial view of the Science Digital Library | 16 | 5 | | | | 100 |
| 2. Ease of getting started with the Science Digital Library | 14 | 7 | | | | 98 |
| 3. Appropriateness of fonts in the Science Digital Library | 15 | 6 | | | | 99 |
| 4. Display of images contained in the Science Digital Library | 17 | 4 | | | | 101 |
| 5. Language used in the Science Digital Library | 17 | 4 | | | | 101 |
| 6. Ease of navigation in operating the Science Digital Library | 16 | 5 | | | | 100 |
| 7. Ease of accessing flipbooks in the Digital Library | 15 | 4 | 2 | | | 97 |
| 8. Understanding the material after using the Science Digital Library | 15 | 6 | | | | 99 |
| 9. Learning independence with the help of the Science Digital Library | 16 | 3 | 2 | | | 98 |
| 10. Interest in learning by using the Science Digital Library | 17 | 4 | | | | 101 |
| GAIN SCORE | | | | | | 994 |
| MAXIMUM SCORE | | | | | | 1.050 |
| PERCENTAGE | | | | | | 95% |

The results of the response questionnaire of grade VI students of Sidoharjo 1 Elementary School, Tuban Regency, showed a percentage obtained of 95%, meaning that these results indicate validity or students agree that the Science Digital Library is effectively used for learning Natural Sciences on Plant Breeding material. Thus, the Science Digital Library is feasible to apply in learning in grade VI elementary school.

**Evaluation**

The evaluation stage is the final stage in the development of the Science Digital Library. At this stage, the Science Digital Library is utilized to implement science learning. Researchers conducted Science learning with the Science Digital Library to improve the science literacy of grade VI students of Sidoharjo 1 Elementary School, Tuban Regency. Learning was carried out for 21 learners. In learning activities, students get guidance from researchers on how to access the Science Digital Library. Researchers display the Science Digital Library through a projector. In the science learning process, researchers use Chromebooks to distribute to students. Chromebooks are used to access the Science Digital Library online learning.

In the process of using the Science Digital Library in the learning process, an evaluation was conducted through a posttest to students to determine the improvement of science literacy. Science literacy assessment instruments measure science literacy skills. The increase was calculated by the normalized gain formula (g) with the result of 0.71.

The results of this study are relevant and support previous studies that have been conducted by Latif and Faisal (2021) with the title Efforts to Improve Student Science Literacy through Computer-Based Science Learning Media, stating that the form of computer-based learning media used in science learning to improve science literacy consists of various forms, namely learning multimedia, interactive E-books, E-modules, animated videos, and android-based media. In addition, the use of computer-based media in science learning has an impact on improving students' science literacy skills. These results show that computer-based media that have been developed by researchers in the form of Science Digital Library play a role in improving students' science literacy in science learning.

The challenges faced by researchers at the evaluation stage can be improved in future research. The challenges faced were related to the internet network when accessing the Science Digital Library. Access to this media development depends on the internet network.

## Conclusion

Based on the results of research conducted on the development of interactive learning multimedia in learning science material on Plant Breeding in grade VI students of Sidoharjo 1 Elementary School, it can be concluded that (1) the digital library developed by researchers for learning science material on Plant Breeding is feasible and valid to use according to the results of the assessment of material experts and media experts; (2) the digital library developed by researchers for learning science material on Plant Breeding can improve science literacy in grade VI students of Sidoharjo 1 Elementary School. The digital library developed by researchers to learn science material on plant breeding can improve science literacy in grade VI students.

Suggestions that can be submitted by researchers regarding development research are (1) digital libraries in Science Learning on Plant Breeding material that has been developed can be a learning medium for other topics and subjects by adding more diverse digital books; (2) with the digital library that researchers have developed, it is hoped that there will be more digital media development from other researchers so that it can improve children's science literacy.

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