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# ANALYSIS OF ELEMENTARY SCHOOL STUDENTS' SCIENTIFIC LITERACY ABILITIES AFTER USING A MICROSITE-BASED *DETEKTIF CONAN* LEARNING MEDIUM ON RENEWABLE ENERGY MATERIAL

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## ABSTRACT

This study aims to describe the scientific literacy profile of elementary school students after using Detective Conan microsite-based learning media on renewable energy material. This research employs a quantitative descriptive method. The research subjects were 28 sixth-grade students at SDN Madyopuro 6, Malang City, selected through purposive sampling. The research instrument was a scientific literacy test consisting of 15 questions covering three aspects: explaining scientific phenomena, evaluating and designing investigations, and interpreting data and evidence. Data were analyzed using descriptive statistics in the form of percentages and categories. The results showed that students' scientific literacy was in the sufficient category, with an average percentage of 68.5%. The highest aspect was explaining scientific phenomena (72.3%, good category), while the lowest aspect was interpreting data and evidence (63.8%, sufficient category). These findings indicate that the Detective Conan microsite-based media has the potential to support scientific literacy but still requires strengthening in the aspect of data interpretation. This research implies that teachers can use this media as an alternative science learning tool that is engaging and stimulates scientific thinking.

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## INTRODUCTION

Scientific literacy is a fundamental competency that students must master in the 21st century. Scientific literacy not only involves understanding scientific concepts but also encompasses the ability to apply scientific knowledge in daily life and make informed decisions based on scientific reasoning (OECD, 2023). According to the PISA 2025 framework, scientific literacy is defined as an individual's capacity to engage with science-related issues and scientific ideas as a reflective citizen (OECD, 2023).

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Despite the importance of scientific literacy, the performance of Indonesian students remains concerning. The 2022 PISA assessment results placed Indonesia at 65th rank with a science score of 383, reflecting a decline of 13 points from the global average score decrease (T. T. D. Susanto et al., 2024). At the local level, data from the Regional Competency Test (*Uji Kompetensi Daerah*, UKD) in Malang City showed that literacy outcomes at SDN Madyopuro 6 had not met the expected targets, with a 5.56% score decline from 2024 to 2025.

The Indonesian government has introduced initiatives such as the School Literacy Movement and the integration of literacy into the Merdeka Curriculum (Harianto & Fahriani, 2024). However, these efforts have not yielded optimal results. One contributing factor is the limited availability of digital learning media that aligns with students' daily media habits (Nurhikmah et al., 2023) . Preliminary observations suggest that students spend considerable time engaging with digital devices, primarily for entertainment rather than educational purposes (Soepardi, 2023). This situation suggests a potential opportunity to develop learning media that bridges students' familiarity with digital content and the need for meaningful science learning.

One promising approach is the use of popular culture characters that appeal to elementary school children. Detective Conan, a widely popular anime, holds significant appeal for elementary school students. The character of a young, intelligent detective who consistently solves mysteries using scientific logic can serve as an engaging role model for scientific thinking. Research by (Laeli et al., 2023) demonstrated that detective-context-based learning media can effectively support critical thinking skills in elementary science education.

The Detective Conan learning media developed in this study is a microsite-based medium that incorporates the DETEKTIF approach: *Deteksi* (Detection), *Aktif* (Active), *Coba* (Try), and *Terapkan* (Apply). The media guides students through systematic stages of learning about renewable energy. The "Detection" button presents video-based problem identification of the energy crisis. The "Active" button provides interactive material on various types of renewable energy. The "Try" button features simulations and quizzes for hands-on experimentation. The "Apply" button administers a scientific literacy test to assess student understanding. Other interactive media for renewable energy have also been developed, such as discovery learning-based infographic media (Marita et al., 2025), though the microsite format with a detective context offers a distinct narrative-driven approach.

Several studies have explored the development of microsite-based learning media. (Hayu & Suciptaningsih, 2024) developed a microsite for Pancasila material in elementary schools, while (Keumala et al., 2024) developed a microsite to improve learning outcomes in vocational high schools. (Apriliyani et al., 2026) further developed a microsite-based learning medium specifically for elementary science literacy, through their study focused on media development and validation rather than on describing students's scientific literacy profiles. However, a critical research gap remains: no previous study has specifically described elementary school students' scientific literacy ability after using microsite-based media with a Detective Conan context on renewable energy material. Existing research has focused primarily on cognitive learning outcomes (Keumala et al., 2024) , general literacy (Dolu, 2024), or has been conducted at the secondary level (Fitriana et al., 2024). Furthermore, most previous studies employed pre-experimental designs that attempted to measure the "effectiveness" of media without providing a detailed profile of students' scientific literacy across different competency aspects (explaining phenomena, designing investigations, and interpreting data). Consequently, it remains unclear which aspects of scientific literacy are most and least developed when students learn with such media, and what specific pedagogical reinforcements are needed.

Therefore, this study aims to describe the scientific literacy profile of elementary school students' after using the Detective Conan microsite-based learning media on renewable energy material. Specifically, this study addresses the following research questions: (1) What is the overall profile of students' scientific literacy ability after using the Detective Conan microsite-based media? (2) How do students perform on each aspect of scientific literacy (explaining scientific phenomena, evaluating and designing investigations, and interpreting data and evidence)? and, (3) Which indicators within each aspect demonstrate the highest and lowest levels of student achievement? The results of this analysis are expected to provide an empirical profile of students' scientific literacy, identify specific strengths and weaknesses, and inform future refinements of the learning media and instructional strategies.

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## METHOD

This study employed a quantitative descriptive research design. A quantitative descriptive approach aims to describe a phenomenon or population situation systematically, factually, and accurately based on numerical data (Sugiono, 2019). This design was selected because the primary objective of this study was to describe the profile of students' scientific literacy ability after using the Detective Conan microsite-based learning media, rather than to test causal relationships or compare treatment effects. Microsite-based media have been shown to be feasible for elementary school students (Apriliyani et al., 2026), supporting the choice of this format for the present study**.** Consequently, this study does not include a control group or a pre-test. The absence of a control group and pre-test means that this research cannot make claims about the "effectiveness" of the media in improving scientific literacy; rather, it provides a descriptive snapshot of student performance following the intervention.

The population of this study was all sixth-grade students at SDN Madyopuro 6, Malang City, totaling 28 students. The sample was selected using a purposive sampling technique based on the following inclusion criteria: (1) students who had fully participated in all four learning sessions using the Detective Conan media, (2) students who completed the entire scientific literacy test, and (3) students who were present during the data collection period. All 28 students met these criteria and were therefore included as research subjects. Purposive sampling was deemed appropriate because the study aimed to describe the scientific literacy ability of students who had experienced the complete learning intervention, rather than to generalize findings to a broader population.

The research was conducted from March to May 2026 at SDN Madyopuro 6, Malang City. The school is a public elementary school located in an urban area with adequate technological infrastructure, including a computer laboratory and internet access, which supported the implementation of the microsite-based learning media.

The research procedure consisted of four sequential stages, as follows.

*Stage 1: Preparation.* The researcher prepared the Detective Conan microsite-based learning media, validated the scientific literacy test instrument, and obtained permission from the school principal and the sixth-grade teacher.

*Stage 2: Implementation of learning.* Students participated in four learning sessions (each lasting 70 minutes) using the Detective Conan microsite-based media on renewable energy material. In each session, students navigated the media sequentially through the DETEKTIF stages: Detection (watching problem identification videos), Active (studying interactive content), Try (conducting simulations and completing quizzes), and Apply (preparation for the literacy test). The researcher acted as a facilitator, providing technical assistance when needed but not intervening in the learning content.

*Stage 3: Data collection.* Immediately after the fourth learning session, students were administered the scientific literacy test. The test was conducted in a single 60-minute session under teacher supervision to ensure academic integrity.

*Stage 4: Data analysis.* The completed tests were scored, and the data were analyzed using descriptive statistics as described below.

The research instrument was a scientific literacy test developed by the researcher based on the PISA 2025 scientific literacy framework (OECD, 2023). The test consisted of 15 reasoned multiple-choice questions. Each question required students to select the correct answer and provide a brief justification for their selection. The use of reasoned multiple-choice questions was intended to assess not only factual knowledge but also students' reasoning processes.

The 15 items covered three aspects of scientific literacy as defined by the PISA 2025 framework:

1. Explaining scientific phenomena (6 items): the ability to recognize, offer, and evaluate explanations for a range of natural and technological phenomena.
2. Evaluating and designing scientific investigations (4 items): the ability to describe and appraise scientific investigations and propose approaches to answer scientific questions.
3. Interpreting data and evidence scientifically (5 items): the ability to analyze and evaluate data, claims, and arguments in various representations.

The complete instrument grid is presented in Table 1.

**Table 1.** Grid of the Scientific Literacy Instrument

| Aspect of Scientific Literacy | Indicator | Item Numbers |
|---|---|---|

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| | | |
|---|---|---|
| Explaining Scientific Phenomena | Identifying concepts of renewable energy | 1, 2, 3 |
| | Explaining how solar energy works | 4, 5 |
| | Explaining the benefits of renewable energy | 6 |
| Evaluating and Designing Investigations | Identifying variables in experiment | 7,8 |
| | Designing simple ways to utilize energy | 9,10 |
| Interpreting Data and Evidence | Reading data from tables/graphs | 11,12 |
| | Drawing conclusions from data | 13,14,15 |

Source: Adapted by (OECD, 2023).

The instrument underwent content validation by two experts: a content expert (a lecturer in elementary science education) and an evaluation expert (a lecturer in educational assessment). Each expert rated the relevance, clarity, and representativeness of each item on a 1–4 scale. The content validity index (CVI) was calculated at 0.89, which falls into the "very valid" category according to the criteria established by (Akbar, 2013).

Following content validation, the instrument was pilot-tested on 30 sixth-grade students from a different school (SDN Madyopuro 3, Malang City) who had similar characteristics to the research subjects but were not included in the main study. The pilot test data were analyzed for internal consistency reliability using Cronbach's Alpha coefficient. The obtained coefficient was 0.82, which is considered "very reliable" (Akbar, 2013). Item discrimination indices and difficulty indices were also calculated to ensure that the items appropriately differentiated between high- and low-ability students; all 15 items met acceptable thresholds (discrimination index >0.25, difficulty index between 0.30 and 0.80).

Data were collected through a written test administered in a classroom setting. Students were given 60 minutes to complete the 15-item scientific literacy test. To minimize cheating, students were seated at individual desks with sufficient spacing, and two proctors (the researcher and the classroom teacher) supervised the test administration. Each correct answer was scored 1 point, and each incorrect answer was scored 0 points. For the reasoned multiple-choice format, the reasoning component was used only for qualitative analysis (not reported in this quantitative descriptive study) and did not affect the score. The maximum possible score was 15.

Data were analyzed using descriptive statistics with the following steps:

1. Scoring. Each student's raw score was calculated by summing the number of correctly answered items.
2. Percentage calculation. The percentage of achievement for each aspect of scientific literacy was calculated using the following formula:

$$Percentage = \frac{Total\ score\ obtained\ on\ the\ aspect}{Maximum\ possible\ score\ on\ the\ aspect}\ x\ 100\% \quad \text{.....(1)}$$

The overall percentage was calculated as:

$$Overall\ percentage = \frac{Total\ obtained\ on\ all\ items}{Maximum\ possible\ score} x\ 100 \quad \text{.....(2)}$$

3. Categorization. The calculated percentages were then categorized into five levels of scientific literacy ability based on the criteria adapted from Akbar (2013), as shown in Table 2.

**Table 2.** Categories of Scientific Literacy Ability

| Percentage Range | Category |
|---|---|
| 86%-100% | Very Good |
| 71%-85% | Good |
| 56%-70% | Sufficient |
| 41%-55% | Poor |
| ≤ 40% | Very Poor |

Source: Adapted from Akbar (2013)

4. Frequency distribution. The number and percentage of students falling into each category were calculated and presented in tabular form.

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5. Per-aspect and per-indicator analysis. Mean scores and mean percentages were calculated separately for each of the three aspects and for each indicator within each aspect to identify relative strengths and weaknesses.

All calculations were performed using Microsoft Excel, and results were presented in tables to facilitate interpretation. This study has several methodological limitations that should be acknowledged. First, the absence of a pre-test and a control group means that this study does not attribute the observed scientific literacy levels causally to the Detective Conan media; students' prior knowledge and other confounding variables were not controlled. Second, purposive sampling limits the generalizability of the findings beyond the specific context of SDN Madyopuro 6. Third, the descriptive design does not allow for statistical inference or causal conclusions. Therefore, the findings should be interpreted as a descriptive profile rather than evidence of the media's effectiveness. Future research employing experimental or quasi-experimental designs is recommended to test causal relationships.

## RESULT AND DISCUSSION

### Result

This study was conducted with 28 sixth-grade students at SDN Madyopuro 6, Malang City. The data from the scientific literacy test administered after the use of the Detective Conan microsite-based learning media are presented and described in this section. The analysis covers overall student performance, performance per aspect, and performance per indicator.

**Overall Scientific Literacy Ability**

Table 3 presents the descriptive statistics of students' overall scientific literacy test scores.

**Table 3.** Descriptive Statistic of Student's Scientific Literacy Ability

| Statistic | Value |
|---|---|
| Number of students (N) | 28 |
| Highest score | 14 |
| Lowest score | 7 |
| Mean score | 10.28 |
| Ideal maximum score | 15 |
| Mean percentage | 68.5% |
| Standard deviation | 1.89 |

Source: Research Data, 2026

As shown in Table 3, the mean score of students was 10.28 out of a maximum possible score of 15, corresponding to a mean percentage of 68.5%. The standard deviation of 1.89 indicates that students' scores were relatively homogeneous, with most scores falling within approximately two points of the mean. The highest score achieved was 14 (93.3%), and the lowest was 7 (46.7%), suggesting a moderate range of ability among students.

When converted into the category defined in Table 2, the overall mean percentage of 68.5% falls within the Sufficient category (56–70%). This finding indicates that, on average, students demonstrated an adequate but not yet proficient level of scientific literacy after using the Detective Conan microsite-based media.

Table 4 presents the frequency distribution of students' scientific literacy ability across the five performance categories.

**Table 4.** Descriptive Statistic of Student's Scientific Literacy Ability

| Category | Score Range | Frequency | Percentage |
|---|---|---|---|
| Very Good | 13–15 | 4 | 14.3% |
| Good | 11–12 | 9 | 32.1% |
| Sufficient | 8–10 | 11 | 39.3% |
| Poor | 6–7 | 3 | 10.7% |
| Very Poor | ≤5 | 1 | 3.6% |

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| | | |
|---|---|---|
| Total | 28 | 100% |

Source: Research Data, 2026

Table 4 reveals that the majority of students (39.3%) were in the Sufficient category, followed by the "Good" category (32.1%). Only 14.3% of students achieved the Very Good category. Conversely, 10.7% of students fell into the Poor category, and 3.6% were in the Very Poor category. These data suggest that while more than half of the students (32.1% + 14.3% = 46.4%) achieved at least a "Good" level of scientific literacy, a notable proportion (10.7% + 3.6% = 14.3%) remain at below-sufficient levels and require targeted instructional support.

**Scientific Literacy Ablitiy by Aspect**

Table 5 presents the mean scores and mean percentages for each of the three scientific literacy aspects assessed in this study.

**Table 5.** Scientific Literacy Ability per Aspect

| Aspect | Mean Score | Mean Percentage | Category |
|---|---|---|---|
| Explaining Scientific Phenomena | 4.34 | 72,3 % | Good |
| Evaluating and Designing | 2.88 | 72% | Good |
| Interpreting Data and Evidence | 3.19 | 63,8% | Sufficient |
| **Average** | **10.28** | **68,5%** | **Sufficient** |

Source: Research Data, 2026

As shown in Table 5, the highest-performing aspect was Explaining Scientific Phenomena, with a mean percentage of 72.3% (Good category). The second-highest was Evaluating and Designing Investigations, with a mean percentage of 72.0% (Good category). The lowest-performing aspect was Interpreting Data and Evidence, with a mean percentage of 63.8% (Sufficient category). The gap of 8.5 percentage points between the highest and lowest aspects suggests that students' ability to interpret data and draw evidence-based conclusions is considerably less developed than their ability to explain scientific phenomena.

**Scientific Literacy Ability by Indicator**

To identify specific strengths and weaknesses within each aspect, a per-indicator analysis was conducted, as presented in Table 6.

**Table 6.** Scientific Literacy Ability per Indicator

| Aspect of Scientific Literacy | Indicator | Mean Percentage |
|---|---|---|
| Explaining Scientific Phenomena | Identifying concepts of renewable energy | 78,6% |
| | Explaining how solar energy works | 71,4% |
| | Explaining the benefits of renewable energy | 67,9% |
| Evaluating and Designing Investigations | Identifying variables in experiment | 73,2% |
| | Designing simple ways to utilize energy | 70,5% |
| Interpreting Data and Evidence | Reading data from tables/graphs | 66,1% |
| | Drawing conclusions from data | 62,5% |

Source: Research Data, 2026

Table 6 reveals several important patterns. The highest-performing indicator was Identifying renewable energy concepts (78.6%, Good category), indicating that students successfully acquired basic factual knowledge about renewable energy types from the Detective Conan media. The second-highest was Identifying variables in an experiment (73.2%, Good

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category), suggesting that the simulation activities in the "Try" feature effectively supported students' understanding of experimental design.

Conversely, the lowest-performing indicator was Drawing conclusions from data (62.5%, Sufficient category), followed closely by Reading data from tables/graphs (66.1%, Sufficient category). Both indicators fall within the Sufficient category and represent the weakest areas of student performance. Notably, even the indicator Explaining the benefits of renewable energy (67.9%), while still in the Sufficient category, was lower than other indicators within the same aspect.

## Discussion

The findings of this study provide a descriptive profile of elementary school students' scientific literacy ability after using the Detective Conan microsite-based learning media on renewable energy material. The overall mean percentage of 68.5% (Sufficient category) indicates that students demonstrated an adequate but not yet proficient level of scientific literacy. This section discusses the findings for each aspect, interprets them in relation to existing theories and previous research, and draws implications for practice and future research.

### Overall Scientific Literacy Perfomance

The finding that students' overall scientific literacy falls within the Sufficient category (68.5%) suggests that the Detective Conan microsite-based media has the potential to support scientific literacy development, but that significant room for improvement remains. This result is comparable to findings from previous descriptive studies of elementary scientific literacy in Indonesia. For instance,(Nurbaya et al., 2023) reported that elementary students' scientific literacy in East Java ranged from 55% to 72%, depending on the school context and student characteristics. Similarly, (Hakqi et al., 2026) found that students' ability to apply scientific concepts to everyday problems was consistently lower than their factual recall ability, a pattern also observed in the present study (where conceptual identification was high at 78.6%, but data interpretation was low at 62.5%).

However, direct comparisons with other microsite-based studies are limited because most previous research focused on cognitive learning outcomes rather than scientific literacy profiles. (Keumala et al., 2024) reported that microsite-based media improved cognitive learning outcomes by an average of 18.49%, but that study did not disaggregate performance by specific scientific literacy competencies. The present study therefore contributes a more nuanced understanding of which specific aspects of scientific literacy are supported by microsite-based media and which require additional instructional attention.

### Aspect of Explaining Scientific Phenomena

The finding that students performed best on the aspect of explaining scientific phenomena (72.3%, Good category) is consistent with the nature of the Detective Conan media. The "Active" button in the media presents animated videos and interactive text that explicitly explain renewable energy concepts in a narrative, detective-themed context. This narrative format aligns with the cognitive theory of multimedia learning (Mayer, 2021),which posits that information presented through both visual and verbal channels, embedded within a coherent story, enhances comprehension and retention.

The particularly high performance on the indicator Identifying renewable energy concepts (78.6%) suggests that students successfully acquired declarative knowledge about types of renewable energy (solar, wind, water, biomass, geothermal) from the media. This finding is encouraging because factual knowledge serves as the foundation for higher-order scientific thinking (OECD, 2023). However, the lower performance on Explaining the benefits of renewable energy (67.9%, Sufficient category) indicates that while students could name renewable energy sources, they were less able to articulate why these sources are advantageous compared to non-renewable alternatives. This may reflect the media's emphasis on identification and definition rather than on comparative analysis and justification. Future iterations of the media could strengthen this indicator by including explicit comparative activities (e.g., "Compare solar energy to coal: what are three advantages of solar?").

### Aspect of Evaluating and Designing Investigation

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The second-highest aspect was evaluating and designing investigations, also in the “Good” category. This finding is likely attributable to the "Try" feature of the Detective Conan media, which includes a simulation of making a simple water wheel. In this activity, students were guided to identify variables (e.g., water flow rate, number of blades, wheel size) and observe their effects on the water wheel's rotation speed. This hands-on simulation provided students with a concrete experience of experimental design, which aligns with the constructivist view that meaningful learning occurs when students actively construct knowledge through direct experience (Piaget, 1972).

The relatively strong performance on Identifying variables in an experiment (73.2%) suggests that the simulation effectively supported students' understanding of what constitutes a variable and how variables can be manipulated. However, the slightly lower performance on Designing simple ways to utilize energy (70.5%) indicates that while students could identify variables in a provided experiment, they were less capable of designing their own energy-utilization strategies from scratch. This finding is consistent with Vygotsky's zone of proximal development (ZPD): students performed better on tasks that were modeled or scaffolded (identifying variables) than on tasks requiring independent transfer (designing their own experiments). For future instructional design, teachers using the Detective Conan media should provide additional scaffolding for open-ended design tasks, such as graphic organizers or step-by-step prompts.

**Aspect of Interpreting Data and Evidence**

The lowest-performing aspect was interpreting data and evidence, which fell into the Sufficient category (63.8%) and was the only aspect not reaching the “Good” category. This finding is concerning because data interpretation is a critical component of scientific literacy, particularly in the PISA framework, which emphasizes the ability to "interpret data and evidence scientifically" as one of three core competencies (OECD, 2023).

The per-indicator analysis reveals that students struggled most with Drawing conclusions from data (62.5%) and Reading data from tables/graphs (66.1%). Several explanations may account for this difficulty.

First, data interpretation requires higher-order cognitive skills specifically analysis, synthesis, and evaluation which are less developed in elementary school students compared to factual recall and comprehension (Nurbaya et al., 2023). According to Bloom's revised taxonomy (Anderson & Krathwohl, 2001) explaining phenomena aligns with the "Understand" level, while interpreting data and drawing conclusions aligns with "Analyze" and "Evaluate" levels, which are more cognitively demanding.

Second, Indonesian elementary science instruction has traditionally emphasized factual memorization over data-based reasoning (T. Susanto et al., 2024). Students in this study may not have had sufficient prior exposure to activities requiring graph reading, table interpretation, and evidence-based conclusion drawing. The Detective Conan media includes an interactive map of renewable energy distribution on the "Active" button, but this feature presents data in a static, one-time manner rather than providing structured practice in data interpretation.

Third, the developmental stage of elementary school students (typically ages 11–12) may constrain their ability to reason abstractly about data. Piaget's theory of cognitive development places students in this age range at the transition between concrete operational and formal operational stages (Piaget, 1972). While students can manipulate concrete objects (as in the water wheel simulation), they may struggle with abstract representations such as graphs and tables. The Detective Conan media could be improved by including guided data interpretation exercises that explicitly connect concrete experiences (e.g., the water wheel simulation) to abstract representations (e.g., a graph showing how water flow rate affects wheel speed). The finding that data interpretation is the weakest aspect is consistent with previous research. (Nurbaya et al., 2023) reported that data interpretation was the most difficult aspect of scientific literacy for elementary students in East Java, with mean scores often falling below 65%. Similarly, (Hakqi et al., 2026) found that students' ability to draw conclusions from tables was significantly lower than their ability to answer factual questions, a gap that persisted even after instructional interventions.

**Critical Comparison with Previous Research**

While the finding that data interpretation is the weakest aspect aligns with (Nurbaya et al., 2023) and Hakqi et al. (2025), this study offers a different perspective on why this difficulty persists. Unlike previous studies that attributed low data interpretation primarily to lack of practice, the present study suggests that the design of the learning media itself may contribute to the gap. Specifically, the Detective Conan media provides rich opportunities for conceptual identification

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(78.6%) and variable identification (73.2%) but offers limited scaffolding for data interpretation. This contrasts with (Dolu, 2024), who found that microsite media with embedded data interpretation exercises produced higher scores in that domain. The implication is clear: microsite media can support data interpretation, but only if the feature is intentionally designed with scaffolded practice, not merely presented as static information.

Furthermore, while (Laeli et al., 2023) reported that detective-context media effectively improved critical thinking, their study did not isolate data interpretation as a separate competency. The present study extends their work by demonstrating that even within an engaging detective context, data interpretation remains a challenge unless explicitly targeted. This suggests that narrative engagement alone is insufficient for developing higher-order data literacy skills; structured pedagogical support is also required.

**Concrete Revisions to the Media**

Based on the findings, the following concrete revisions to the Detective Conan media are recommended specifically to address the data interpretation weakness:

1. Convert the static interactive map into a guided data interpretation module. Instead of simply showing the map of renewable energy distribution, the media should present a series of scaffolded questions: (a) "Which province has the highest solar energy potential?" (b) "Which province has the lowest?" (c) "What pattern do you notice between geography and solar potential?" (d) "Based on this data, which province would you recommend for building a solar power plant? Why?"
2. Add a "Data Detective" mini-game. After the water wheel simulation, students could be presented with a simple graph showing how water flow rate affects wheel speed. Students would be asked to: (a) read the highest and lowest values, (b) describe the trend (as flow rate increases, wheel speed ...), and (c) draw a conclusion about the best flow rate for maximum energy generation.
3. Provide immediate feedback with explanations. For each data interpretation question, if a student answers incorrectly, the media should provide a brief explanation: "Not quite. Look at the table again. Which row has the highest number?" This scaffolds the process of reading data step by step.
4. Include a digital worksheet that guides students through the interpretation process. The worksheet could use sentence starters such as: "Based on the data in the table, I notice that __. This means that ___. Therefore, I conclude that ___."

These revisions transform the media from a passive information delivery system into an active data interpretation training tool, directly addressing the weakest aspect identified in this study.

**Comparison with Previous Research**

In alignment with (Keumala et al., 2024), the present study confirms that microsite-based media can support student learning, with 46.4% of students achieving at least a Good level of scientific literacy. In alignment with (Hayu & Suciptaningsih, 2024), the present study supports the feasibility of microsite media for elementary school contexts, as all 28 students were able to navigate the Detective Conan microsite without significant technical difficulties. These agreements suggest that microsite media are a viable format for elementary science instruction.

However, the present study challenges (Keumala et al., 2024) in one important respect. While (Keumala et al., 2024) concluded that microsite media "improve learning outcomes" based on a pre-experimental design, the present study argues that such causal claims are premature without control groups and pre-tests. The descriptive design of this study reveals that while students achieved sufficient scores, it is unclear how much of this performance is attributable to the media versus students' prior knowledge. This suggests that future research should adopt more rigorous designs before making effectiveness claims.

Unlike (Laeli et al., 2023), which focused on critical thinking in a general sense, the present study specifically examined data interpretation as a separate competency and identified it as an area needing reinforcement. Unlike (Dolu, 2024), which examined general literacy outcomes, the present study applied the internationally recognized PISA 2025 framework, enhancing the comparability and generalizability of findings. Most importantly, unlike all previous microsite studies, the present study provides concrete, actionable revisions to the media based on empirical identification of specific weaknesses.

**Implications of the Findings**

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The Detective Conan microsite-based media can be used as an engaging supplementary resource for teaching renewable energy, particularly for developing students' ability to explain scientific phenomena and design simple investigations. However, teachers should not rely solely on the media for developing data interpretation skills. Additional instructional activities such as small-group discussions of graphs, guided practice in creating tables from experimental data, and explicit instruction in drawing evidence-based conclusions should be integrated with the media.

The interactive map feature on the "Active" button currently presents data in a passive format. To better support data interpretation, developers should convert this feature into an interactive data interpretation module. For example, after viewing the map, students could be presented with a series of questions requiring them to compare data across regions, identify patterns, and draw conclusions. Additionally, a digital worksheet could guide students step-by-step through the process of reading a table, identifying the relevant data, and formulating a conclusion.

The finding that data interpretation is the weakest aspect suggests that the elementary science curriculum should allocate more instructional time to data literacy skills. Rather than treating data interpretation as an advanced skill to be introduced in middle school, foundational data interpretation activities (e.g., reading simple bar charts, identifying the highest and lowest values in a table) should be integrated into elementary science instruction from grade 4 onward.

The descriptive design of this study cannot establish causality. Future research should employ quasi-experimental or experimental designs, including pre-tests, control groups, and larger sample sizes, to test whether the Detective Conan microsite-based media causes improvements in specific aspects of scientific literacy. Additionally, qualitative research (e.g., think-aloud protocols, interviews) could investigate *why* students struggle with data interpretation and which instructional strategies most effectively address this difficulty.

**Limitations of the Study**

Several limitations of this study should be acknowledged. First, the absence of a pre-test and control group means that the observed scientific literacy levels cannot be attributed solely to the Detective Conan media. Students' prior knowledge, home literacy environment, and other confounding variables were not controlled. Second, purposive sampling and the small sample size (N = 28) limit the generalizability of findings to other schools or populations. Third, this study measured scientific literacy immediately after the intervention and did not assess long-term retention or transfer of learning. Fourth, the reasoned multiple-choice format, while more informative than simple multiple-choice, may not fully capture students' reasoning processes, as the justification component was not quantitatively analyzed. Future research should address these limitations by employing more rigorous designs, larger samples, delayed post-tests, and qualitative methods.

## CONCLUSION

This study aimed to describe the scientific literacy profile of elementary school students after using the Detective Conan microsite-based learning media on renewable energy material. Based on the results and discussion presented in the previous section, the following conclusions are drawn. Students' overall scientific literacy was at the Sufficient level (68.5%). While nearly half of the students (46.4%) achieved Good or Very Good levels, 14.3% remained at Poor or Very Poor levels, indicating uneven performance. Across the three scientific literacy aspects, students performed best on Explaining Scientific Phenomena (72.3%, Good) and Evaluating and Designing Investigations (72.0%, Good). The weakest aspect was Interpreting Data and Evidence (63.8%, Sufficient), with the lowest indicators being drawing conclusions from data (62.5%) and reading data from tables or graphs (66.1%). The Detective Conan microsite-based media shows potential to support scientific literacy, particularly for conceptual understanding and experimental design. However, the data interpretation aspect remains a significant challenge that requires targeted instructional support and concrete media revisions, such as guided data interpretation modules and scaffolded worksheets with sentence starters.

These findings contribute empirical evidence that even with engaging, narrative-driven digital media, elementary students' data interpretation skills lag behind their conceptual understanding. This suggests that narrative engagement alone is insufficient for developing higher-order data literacy; structured pedagogical scaffolding is essential. This study also provides a descriptive baseline for improving both the media and instructional practices, particularly for data interpretation. Due to the descriptive design, causal claims cannot be made (see Limitations in the Discussion section). Future experimental research is needed to test causal relationships and the effectiveness of the proposed media revisions.

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