

## Development of kehatimu digital worksheet PjBL STREAM to improve science literacy and creative thinking skills

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### Abstract

#### Keywords:

Creative thinking skills;  
Digital worksheet;  
Science literacy;

Using the environment as a learning environment has great potential to be developed. Biodiversity in Indonesia, including the slopes of Mount Muria, can be used as a source of learning for student participants. Previous studies' results stated that students' Science Literacy and creative thinking skills on Mount Muria's slopes need improvement. There needs to be learning that can trigger and train students' Science Literacy and creative thinking skills to improve these abilities. The science, technology, religious, engineering, art, and mathematics (STREAM) approach can present more meaningful learning, especially if integrated with project-based learning models and IT. This study aims to develop a digital worksheet titled Kehatimu (Keanekaragaman Hayati Muria) with the PjBL STREAM model to improve students' science literacy and creative thinking skills. The method used is R&D with the define, design, development, and disseminate (4D) model. Data collection involved both test instruments (science literacy and creative thinking assessments) and non-test instruments (feasibility and readability questionnaires, as well as attitudinal scales toward science literacy and garden design creativity assessment rubric). The study involved 135 students from three schools located on the slopes of Mount Muria, divided into experimental and control groups. Data analysis using SPSS included the N-Gain and independent t-tests. Expert validation yielded a feasibility score of 0.90 (categorized as very feasible), while readability analysis scored 4.3 (high readability). Results demonstrated that the digital worksheet is interactive, user-friendly, relevant, and contextually grounded. Furthermore, significant improvements ( $p < 0.05$ ) were observed in both scientific literacy and creative thinking scores, with averages exceeding the Learning Mastery Level (LML) threshold of 70. In conclusion, the Kehatimu digital worksheet can improve students' scientific literacy and creative thinking related to Mount Muria's biodiversity.

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### Introduction

Indonesia, with its abundant biodiversity (Setiawan, 2022), as well as the Mount Muria area (Sari et al., 2023), has excellent potential as a natural laboratory for science learning. Utilizing the surrounding environment as a learning resource can improve learning outcomes and student interest (Irwandi & Fajeriadi, 2020). The results of previous studies have shown that the Science Literacy and creative thinking skills of students in Indonesia still need to be improved. As found by Hidayah *et al.* (2019), the average Science Literacy score of junior high school/MTs students in Pati Regency is still low (Hidayah et al., 2019). Similar conditions were

also found in Kudus Regency; research by Rusilowati *et al.*, 2019 showed that students' Science Literacy conditions were still below 50% (Hidayah *et al.*, 2019). This low Science Literacy has implications for students' need for more ability to understand scientific concepts and apply them in everyday life. The creative thinking skills of students in Indonesia, especially in terms of detailing ideas, generating innovations, and solving problems, still need to be improved (Rusilowati *et al.*, 2016). Research by Madyani *et al.* (2020) and Handayani *et al.* (2021) shows that students' creative thinking skills scores are still below the good category. There needs to be learning that can spark and train students' creative thinking skills so that this ability can improve.

To overcome these problems, an innovative and interesting learning approach is needed. Project-Based Learning (PjBL) is an instructional model that emphasizes student-centered inquiry, collaboration, and the creation of meaningful products through extended problem-solving processes. The STREAM-PjBL stages consist of Reflection, Research, Discovery, Application, and Communication. These stages were adapted from the model developed by Laboy-Rush and serve as a structured sequence to implement integrated and meaningful project-based learning (Laboy-Rush, 2010). In this study, the PjBL model was integrated with the STREAM approach, which not only incorporates multidisciplinary learning but also infuses spiritual and moral values into science education. The integration of STREAM has been found effective in enhancing students' creativity and engagement (Tran *et al.*, 2021) and the use of STEAM within project-based learning settings has shown improvements in creative thinking skills (Chang *et al.*, 2023; Pramashela *et al.*, 2023). Prior studies, such as those by Azizah *et al.* (2020) and Pebriani *et al.* (2022), have also demonstrated positive impacts of STREAM-based learning in science classrooms. Additionally, the incorporation of religious elements in STREAM, as highlighted by Mubarok *et al.* (2020), offers a deeper dimension that contextualizes scientific learning within students' spiritual and ethical frameworks. Furthermore, integrating religion and art into the STREAM approach has been shown to enrich the learning context and foster holistic development (Arifani *et al.*, 2024; Azizah *et al.*, 2022; Chistyakov *et al.*, 2023).

In the digital era, the use of technology in learning is becoming increasingly important. The use of technology can make learning more interesting and interactive. One technology that can be utilized is a digital worksheet. Based on previous research, digital worksheets have been shown to be effective in increasing student engagement in learning and supporting the development of 21st-century skills (Mulder *et al.*, 2023; Pebriani *et al.*, 2022). Platforms such as liveworksheet.com offer flexibility, convenience and a variety of interesting features in creating digital worksheets that can be adjusted to learning needs (Ropiatin *et al.*, 2023; Susilawati *et al.*, 2023).

Based on the background above, this study aims to develop a digital worksheet titled Kehatimu (Keanekaragaman Hayati Muria) that differentiates the material of Mount Muria biodiversity with the PjBL STREAM model to improve science literacy and creative thinking skills.

**Method**

The development model used in this study is a modified 4D development model. This development model consists of 4 stages, namely define define, design, develop and disseminate (Thiagarajan et al., 1974) the digital worksheet is prepared at the planning stage. The development stage produces a digital worksheet that is feasible and tested to improve the science literacy and creative thinking skills of junior high school or islamic junior high school students.

The development stage begins with the creation of digital worksheet. Then, a feasibility test is carried out, and validation is done by material and media experts. The media expert involved is a university lecturer specializing in instructional materials and educational media, while the material experts are lecturers in the science education program who teach fundamental science concepts and science teaching methodologies. A total of four experts participated in the validation process, two media expert and two material experts.

The feasibility of the Digital Worksheet is analyzed based on expert assessments covering didactic, construction, and technical aspects these three components are essential to ensure the worksheet is pedagogically sound (didactic), well-structured and logically sequenced (construction), and functionally operable in digital format (technical), which are then assessed for content validity using Aiken's V coefficient formula (Aiken, 1980). The results of calculating the content validation coefficient using the Aiken's V coefficient formula are then categorized based on the criteria in Table 1.

**Table 1.** Digital Worksheet Validation Categories using Aiken's V Validity

Validity coefficient	Category
$0 < V \leq 0.4$	Not worthy
$0.4 < V \leq 0.8$	Worthy
$0.8 < V \leq 1$	Very worthy

The readability of the digital worksheet was analyzed based on assessments from teachers and students in small group trials covering aspects of material, appearance, and ease. Then the average value of the three aspects was determined and grouped into three categories, namely high, medium, and low. The criteria for each aspect can be seen in Table 2.

**Table 2.** Readability Test Criteria

Score Category Range	Category
$3.4 \leq \bar{X} \leq 5$	High
$1.7 \leq \bar{X} \leq 3.3$	Medium
$0 \leq \bar{X} \leq 1.6$	Low

The effectiveness of the digital Worksheet developed was tested using quasi-experimental designs with a nonequivalent control group design (Sugiyono, 2008). The effectiveness of the digital worksheet was seen based on the N-Gain, t-test, and learning objective completion criteria tests. The test used a science literacy test adapted from Scientific Literacy Assesment (SLA), which consists of two components: SLA-D (Scientific Literacy Assessment – Demonstrated), used to measure students' scientific knowledge and content understanding; and SLA-MB (Scientific Literacy Assessment – Motivation and Belief), used

to assess students' attitudes, motivation, and beliefs toward science (Eymur & Çetin, 2024; Rohana et al., 2020), as well as a creative thinking skills test adapted from Creative thinking skills were assessed using the Torrance Tests of Creative Thinking (TTCT) which evaluates verbal fluency, flexibility, and originality (Idrus, 2022; Trisnayanti et al., 2019) and an assessment of creativity in drawing biodiversity friend designs (Deswanty et al., 2024). The subjects of the trial were junior high school students located in the slopes of Mount Muria. The small-scale trial involved 27 ninth-grade students in 3 junior high schools/Islamic junior high schools, and the class-scale trial involved 135 eighth-grade students in 3 junior high schools/Islamic junior high schools on the slopes of Mount Muria.

The criteria for selecting the research schools were schools located in the slopes of Mount Muria, having various characteristics (state or private, madrasah schools and accreditation), implementing the Independent Curriculum, and having at least two study groups to allow for a quasi-experimental research design. In addition, these schools also have religious programs as part of their learning activities to support students' religiosity. The selected schools represented diverse characteristics: two public junior high schools (SMP Negeri) and one Islamic junior high school (Madrasah Tsanawiyah). In terms of accreditation, two schools held accreditation A, while one school held accreditation B. This diversity was intended to ensure broader applicability and contextual relevance of the developed learning tool across different school types and quality levels.

The N-Gain test is used to test the difference in the average increase in students' science literacy competency scores based on the pretest and posttest scores of the experimental and control groups. The N-Gain test is calculated using the following formula (Hake, 2002):

$$g = \frac{\% \text{ Skor posttes} - \% \text{ skor pretest}}{100 - \% \text{ pretest}}$$

Then, the obtained N-gain values are grouped according to the criteria in Table 3 (Hake, 2002).

**Table 3.** Pretest and Posttest N-Gain Criteria

N gain value	Criteria
$g \geq 0.7$	High
$0.7 \leq g < 0.3$	Medium
$g < 0.3$	Low

Analysis of t-test data using independent sample t-test conducted using SPSS 25. If t-value  $< 0.05$ , then  $H_a$  is accepted, while if t-value  $> 0.05$ , then  $H_o$  is accepted.  $H_a$  shows that the experimental group using digital worksheet is more effective in improving students' Science Literacy and creative thinking skills compared to the control group that only uses textbooks and  $H_o$  is less effective in improving students' Science Literacy skills or there is no difference between the experimental group and the control group. Meanwhile, students meet the Learning Mastery Level (LML) if they get a score of more than 70, and if the LML score of a class is more than 80%, it means that learning has been completed.

## Results and Discussion

### Product Development

The developed digital worksheet has characteristics that are in accordance with didactic, construction and technical aspects. Digital worksheets have various features supporting Science Literacy training and creative thinking skills. For example, the “Ayo berpendapat” feature allows students to be trained to express their ideas in writing based on their understanding of the previous content. The "Qur'an Corner" feature is able to provide an overview that the Quran is a source of knowledge (Supendi et al., 2022). In addition, the "Let's Create" feature, which encourages students to create projects, is in line with research by Yamin et al. (2020) and has been proven effective in improving creative thinking skills. Research by Demir (2021) and Setyaningrum et al. (2023) also supports the use of digital worksheets in differentiated learning that can accommodate diverse learning needs. Simple language, clear structure, and various interesting activities make digital worksheets easy for students to understand and enjoy, as supported by research by Ropiatin et al. (2023) and Susilawati et al. (2023). Technically, digital worksheets also have advantages in terms of accessibility and ease of use, as emphasized in the research of Azizah et al. (2023) and Laksono et al. (2023). Examples of features in the Digital worksheet can be seen in Figure 1.



Figure 1. Cover and Example of Feature Display on Digital Worksheet

Based on the results of the feasibility through expert validation tests by 2 material experts and 2 teaching material experts, the digital worksheet developed has an Aiken-V Index of 0.90 with a very feasible category. The results of the experts' feasibility of the digital worksheet can be seen in Table 4.

Table 4. Results of Digital Worksheet Feasibility Test by Experts

Aspect	Aiken-V Index	Category
Didactic	0.89	Very Worth It
Construction	0.91	Very Worth It
Technical	0.90	Very Worth It
Average	0.90	Very Worth It

The results of the feasibility test indicate that the digital worksheet has met the required didactic, construction, and technical aspects, and it can be concluded that the digital worksheet is very feasible to use. These results are in line with the research of Khaldun and Winarni (2024) and Zai & Ulianas (2023) which show that an Aiken V value above 0.89 indicates the feasibility of a learning product. However, to continue improving quality, several improvements need to be made based on expert input.

Based on expert advice, several aspects need to be improved in the digital worksheet. In terms of material construction, content enrichment needs to be carried out, such as adding examples of gene-level biodiversity and providing clear sources for each identification. Technical aspects also need to be improved, for example, by improving the cover design and drag-and-drop menu display and replacing less relevant images or videos. These improvements aim to improve the appearance, user experience, and effectiveness of the digital worksheet as a learning tool. Examples of suggestions for improvement and follow-up can be seen in Table 6.



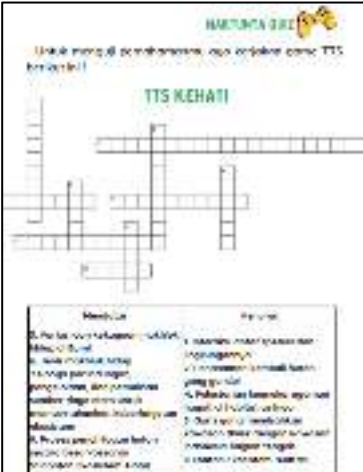

The results of the digital readability test of the digital worksheet conducted by teachers showed that overall, digital worksheet has high readability. The average teacher's assessment on the aspects of material, appearance, and ease reached a score of 4.8. More details can be seen in Table 5.

**Table 5.** Digital Readability Test Results Worksheet

Respondents	Average Per Aspect				Category
	Material	Appearance	Convenience	Average	
Teacher	4.9	4.8	4.8	4.8	High Readability
Learners	3.7	3.7	3.8	3.7	High Readability
Average	4.3	4.3	4.3	4.3	High Readability

These results indicate that the developed *digital worksheet* has met the criteria for high readability and can be easily understood by users. This is in line with the research of Amalia et al. (2022), which states that digital worksheets developed through the liveworksheet.com page have the advantage of interactivity. In addition, the attractive design and layout of the digital worksheet and the ease of use of its features also received positive assessments from teachers. These results indicate that the digital worksheet has been well-designed and can be an effective learning tool.

**Table 6.** Examples of Suggestions and Improvements to Digital Worksheets

Improvement Suggestions	Follow-up
Add another example of diversity at the genetic level	Adding the diversity of Remebete ( <i>Lantana camara</i> ) as an example of genetic-level biodiversity
	
“Cossword Puzzle” game is replaced with another type so it is easier to operate	Replacing the “Cossword Puzzle” game with a “Word search” game related to biodiversity
	

The results of the readability test by students also showed that the digital worksheet was well-designed and easy to understand. Interesting visual aspects, such as images and videos, attracted students' interest. This is in line with research by Azizah et al. (2023), who agreed that the presence of videos and images is an advantage of digital worksheets. However, there are still some suggestions for improvement that need to be considered, such as replacing the Cossword Puzzle game with a word search game and technical improvements. These suggestions aim to improve the quality of content, interactivity, and accessibility of digital worksheets so that they can be a more effective and interesting learning tool for students. Examples of suggestions for improvement and follow-up can be seen in Table 6.

**Product Effectiveness**

The digital worksheet product was carried out by calculating the N-gain value, the Learning Mastery Level (LML) and statistical tests to measure the significance of the differences using the t-test. These results are important to determine the extent to which the PjBL STREAM-based differentiated digital worksheet improves students' Science Literacy and creative thinking skills.

One of the indicators of the effectiveness of the digital worksheet in this study is the N-Gain test. The results of the N-Gain calculation between the control class using the textbook and the experimental class using the digital worksheet can be seen in Table 7.

**Table 7.** Results of N-Gain Test Calculation for Each Variable

School	N Gain SLA D				N Gain SLA MB				N Gain TTCT-V			
	EC	Cat	CC	Cat	EC	Cat	CC	Cat	EC	Cat	CC	Cat
MTs Raudlatul Falah Pati	0.6	Medium	0.4	Medium	0.8	Medium	0.05	Low	0.3	Medium	0.1	Low
SMPN 2 Bae Kudus	0.6	Medium	0.4	Medium	0.4	Medium	0.3	Medium	0.3	Medium	0.1	Low
SMPN 1 Nalumsari Jepara	0.7	Medium	0.5	Medium	0.3	Medium	0.1	Low	0.5	Medium	0.1	Low

Note: (EC) Experimental Class, (CC) Control Class, (Cat) Category

Based on the results of the N-Gain analysis , the use of the digital worksheet kehatimu in the experimental class showed an increase in the three variables measured. The results of the N-Gain analysis showed an increase in students' abilities after being given treatment. The most significant increase was seen in the attitude towards science (SLA-MB) at MTs. Raudlatul Falah Pati. Meanwhile, SMPN 2 Bae Kudus showed a fairly good increase in the aspects of knowledge (SLA-D) and attitudes (SLA-MB), while SMPN 1 Nalumsari Jepara showed a significant increase in the aspects of attitudes and creative thinking skills (TTCT-V).

N-Gain results were then reinforced by significant t-test results. The results of the t-test can be seen in Table 8.

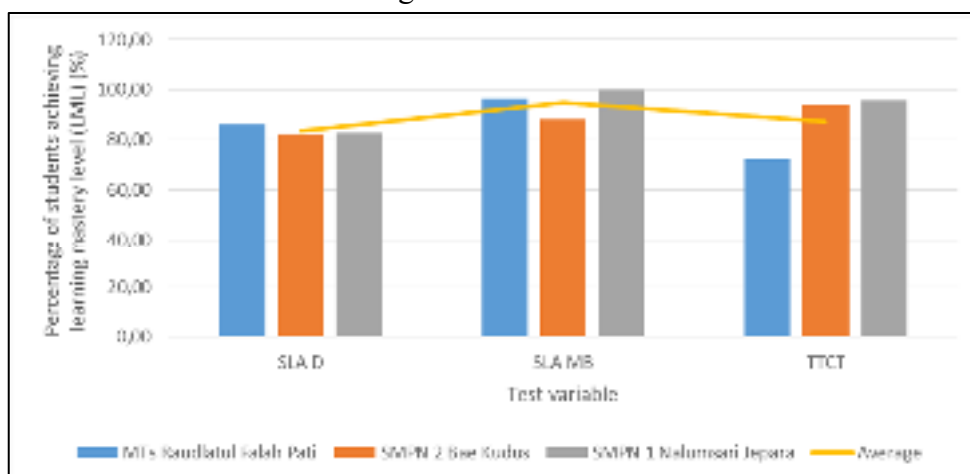
**Table 8.** Results of t-Test for Each School

School	SLA D			MB SLA			TTCT-V		
	t	df	Sig. (2-tailed)	t	df	Sig. (2-tailed)	t	df	Sig. (2-tailed)
MTs Raudlatul Falah Pati	3,850	55	0,000	7,714	55	0,000	7,471	55	0,000
SMPN 2 Bae Kudus	3,555	32	0.002	3,431	32	0.002	6,503	32	0,000
SMPN 1 Nalumsari Jepara	3,467	42	0.001	3,112	42	0.003	7,526	42	0,000

Based on Table 6, the significance value of Sig. (2-tailed) For all variables, namely science literacy of knowledge domain (SLA D), Science Literacy of attitude domain (SLA MB), and creative thinking skills (TTCT), it is smaller than 0.05. In addition, the calculated t value for each aspect of SLA D, SLA MB, and TTCT is greater than the t table. So  $H_a$  is accepted, and  $H_0$  is rejected. Thus, it can be concluded that the use of digital worksheet provides a better influence in improving science literacy and creative thinking skills.

The effectiveness of the digital worksheet is also seen from the achievement of the learning mastery level (LML). The results of the percentage of students who achieved LML in

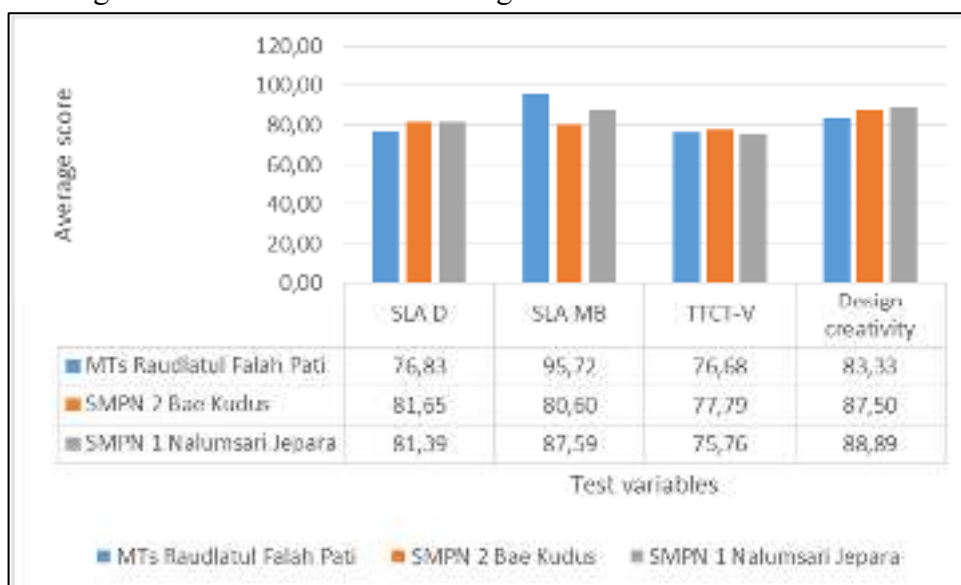
the post-test of science literacy (SLA D and SLA MB) and creative thinking skills (TTCT) of the experimental class can be seen in Figure 2.



**Figure 2.** Percentage of Students Achieving LML

Based on the data in Figure 2, it can be seen that in general, the use of the digital worksheet gives positive results on the number of students who achieve the learning objective completion criteria. The percentage of students in the experimental class who achieved the LML in the three variables reached 80% except for the TTCT-V variable at MTs. Raudlatul Falah Pati indicates that the digital worksheet is effective in helping students master science literacy and creative thinking skills. In the creative thinking skills test, the percentage of students at MTs. Raudlatul Falah who achieved the LML was only 72.41%, this result is different from the results in other schools because students are not yet accustomed to thinking creatively. The training on the digital worksheet has been designed in such a way that it has not reached 80%.

When compared with the average results, the science literacy and creative thinking skills scores have exceeded the specified LML, namely 70. Details of the average science literacy and creative thinking skills scores can be seen in Figure 3.



**Figure 3.** Average Score of Science Literacy and Creative Thinking Skills

Figure 3 shows the average results of science literacy scores and creative thinking skills in each school, showing optimal results. The science literacy scores in both the knowledge (SLA-D) and attitude (SLA-MB) dimensions exceeded the minimum score on the LML. The creative thinking skills score on the TTCT test exceeds the minimum score on the LML. This is supported by the results of the garden design creativity carried out in groups, which also exceeded the minimum score on the LML. These results answer doubts about the effectiveness of the LML based on the results of each individual. When viewed based on the average, the results have met the LML test criteria. The results of this study are in line with several previous studies. The STREAM PjBL approach that encourages students to explore problems and find solutions is in line with the findings of previous studies. Kurniasari et al. (2023) and Muhibbuddin et al. (2020) have proven that the PjBL model contributes significantly to improving students' science literacy. The integration of art and religious dimensions in the STREAM model also has a positive impact, as shown by research by Chistyakov et al. (2023), Arifani et al. (2024), and Azizah et al. (2022).

In addition to improving science literacy, using digital worksheets based on PjBL STREAM has also proven effective in improving students' creative thinking skills. Research by Putri et al. (2023), Khalil et al. (2023), Jawad et al. (2021), Chang et al. (2023), Tran et al. (2021), and Agustina et al. (2019) shows that project-based learning, especially those integrating STEM or STREAM, can stimulate students' creativity. Through the projects presented in the digital worksheet, students are trained to explore new ideas and find innovative solutions, thus encouraging the development of their creative thinking skills.

## **Conclusion**

The development of the kehatimu digital worksheet with the PjBL STREAM model meets the expert's eligibility with a very feasible category. The readability analysis of the readability of the digital worksheet obtained a score of 4.3 with a high readability category. It was declared feasible based on the eligibility and readability results for the digital worksheet. The results of the N-Gain test of science literacy and creative thinking skills in the experimental and context classes in all schools showed an increase in all variables. The results of the t-test reinforce these results. The significance value of Sig. (2-tailed) the value is less than 0.05 for all variables, so  $H_a$  is accepted and  $H_o$  is rejected. Based on the LML test, the average score for science literacy and creative thinking skills exceeded 70, meaning it met the LML test. Thus, the digital worksheet can improve students' science literacy and creative thinking skills related to the biodiversity of Mount Muria.

## **Credit Authorship Contribution Statement**

**Muhammad Mujahidus Shofa:** Conceptualization, Methodology, Software, Visualization, Formal analysis, Writing – original draft, Writing – review & editing. **Sri Ngabekti:** Conceptualization, Methodology, Formal analysis, Resources, Writing – review & editing, Supervision. **Sunyoto Eko Nugroho:** Conceptualization, Methodology, Formal analysis, Resources, Writing – review & editing, Supervision.

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