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# The Influence of the Application of the Science, Technology, Engineering, and Mathematics (STEM) Approach Assisted by Assemblr Edu on Improving the Scientific Literacy Skills of Elementary School Students

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**Abstract**: This study is motivated by the low level of scientific literacy skills among students. The objective of this research is to measure the improvement and determine the influence of learning using the STEM approach assisted by Assemblr Edu, compared to learning that uses the Scientific approach. The research method employed is Quasi-Experimental with a non-equivalent control group design and purposive sampling technique. The research sample consists of 30 students in both the experimental and control groups. The instruments used in this study include a scientific literacy skills test and non-test instruments such as student worksheets and documentation. Data analysis results show that learning with the STEM approach assisted by Assemblr Edu has a significant influence on students' scientific literacy skills, with an effect size of 57.6%. Based on these results, it can be concluded that the STEM approach assisted by Assemblr Edu has a significant correlation and positive impact on scientific literacy skills. Learning through the application of the STEM approach assisted by Assemblr Edu demonstrates an influence of 57.6%, indicating that the implementation of the STEM approach assisted by Assemblr Edu impacts the improvement of students' scientific literacy skills.

**Keywords**: STEM Approach, Science Literacy Skills, Assemblr Edu

## INTRODUCTION

Education continues to evolve in the 21st century, with deeper integration between technology, knowledge, attitudes, and skills (Oktarina et al., 2023). This aligns with the concept of 21st-century learning, which continuously strives to improve the quality of education through curriculum development, teaching methods, and the use of technology. One way to enhance educational aspects is to start at the elementary school level. Elementary schools aim to provide foundational knowledge and hone students' basic skills (Ifrida et al., 2023).

Elementary school serves as a crucial foundation for instilling basic knowledge in students by covering various subjects, one of which is natural science. Natural Science (IPA) is a key component of the elementary school curriculum, designed to develop an understanding of the natural world, scientific processes, and the application of scientific concepts in daily life (Miqwati et al., 2023). Moreover, the 21st century demands strong scientific literacy skills and STEM (Science, Technology, Engineering, and Mathematics) competencies. Therefore, advancements in science and technology require individuals to possess, among other things, strong scientific literacy skills.

Literacy is a critical aspect of elementary education. In Indonesia, six types of literacy have been developed, one of which is scientific literacy. Scientific literacy is a 21st-century skill and a necessary competency for every individual. Without scientific literacy, individuals cannot comprehend and understand scientific concepts or solve problems related to the natural world

(Banila et al., 2021). According to Gormally et al. (2012), indicators of scientific literacy include identifying valid scientific opinions, conducting appropriate literature searches, solving problems using everyday observations, and understanding elements of experimental design. Hence, Natural Science and scientific literacy skills are vital because they are the key to understanding natural phenomena, making evidence-based decisions, and participating in technological development. However, the process of teaching Natural Science often faces challenges in maintaining students' interest and engagement, especially amid rapid technological advancements.

Research findings on students' scientific literacy skills in Natural Science learning indicate that most students have low levels of scientific literacy. This is evidenced by their difficulties in answering science-related questions, as seen from the structure of their responses, which often fail to correctly address basic scientific concepts (Surya, 2023). This lack of understanding of scientific concepts can result in students' inability to connect Natural Science concepts to real-life situations.

Encouraging students to actively engage in solving scientific problems has proven to be a challenge. The poor scientific literacy skills among students are attributed to various factors, primarily their tendency to merely listen, memorize, and copy the content provided by the teacher without finding meaning or understanding the underlying concepts and their applications (Lehan et al., 2023). This aligns with previous research from Irsan (2021), which highlighted the low level of student engagement, the lack of adequate learning media for literacy activities, leading to misconceptions. Additionally, the learning process has emphasized knowledge and understanding of the material rather than focusing on developing scientific literacy skills. As a result, students' scientific literacy skills, particularly in the aspects of scientific attitudes and knowledge, remain low. This is evident from the absence of evaluation data showing students' scientific literacy skills (Yusmar, 2023).

One of the teaching approaches recognized for enhancing scientific literacy skills is the Science, Technology, Engineering, and Mathematics (STEM) approach. This approach emphasizes the integration of these four disciplines in a problem-based learning context, fostering student engagement and experiential learning. However, to provide a more engaging and interactive learning experience, the STEM approach requires the support of innovative educational technology. Assemblr Edu is one digital platform that offers various tools and resources to support STEM learning. By combining visual elements, simulations, and interactivity, Assemblr Edu can enhance student engagement and understanding in STEM learning.

In line with previous research on the influence of the STEM approach and the use of Assemblr Edu as a learning tool, two key studies are noteworthy. First, Dhini (2022) found that students in the experimental group taught with the STEM approach demonstrated better scientific literacy skills than those in the control group. Second, Choirunnisa (2023) showed that Assemblr Edu in Natural Science learning is suitable as a teaching aid. This conclusion is based on the background explanation of the problem and reaffirms the findings of previous studies. The purpose of this research is to determine the influence of the STEM approach on improving scientific literacy skills using technology-based learning, particularly Assemblr Edu, as an innovative tool that can be utilized by fourth-grade students in Natural Science subjects.

## METHOD

This study is quantitative and employs a quasi-experimental methodology with a non-equivalent control group design (Sugiyono, 2018). This approach was chosen because the study aims to measure the improvement and determine the effectiveness of learning using the STEM approach assisted by Assemblr Edu compared to learning that uses the Scientific approach. The sampling technique used is purposive sampling. The study selected Class IV A and IV B from UPTD SDN 1 Nagrikidul as the sample groups, with each class consisting of 30 students. Class IV A, with 30 students, served as the experimental group, while Class IV B, with 29 students, served as the control group. The population in this study included all fourth-grade elementary school students in Purwakarta Regency.

The study was conducted over five sessions. The first session involved the administration of a pretest on April 30, 2024. The second to fourth sessions involved the application of treatments from April 30, 2023, to May 21, 2024. The fifth session included the administration of a posttest on May 21, 2024.

Data were collected using both test and non-test techniques. The test technique included pretests and posttests, while the non-test technique included student worksheets and documentation. The researcher administered tests to students to measure their level of scientific literacy. The scientific literacy test consisted of five essay questions. The collected data were then analyzed using SPSS version 24.0 to determine whether the improvement in scientific literacy skills among students who used the STEM approach assisted by Assemblr Edu was greater than among those who used the Scientific approach. Additionally, the analysis sought to determine the influence of the STEM approach assisted by Assemblr Edu on students' scientific literacy skills.

Prior to the intervention, both classes underwent a pretest to establish baseline conditions. Following this, the experimental class used the STEM approach assisted by Assemblr Edu, while the control class received the Scientific approach. Both groups then completed a posttest, and conclusions were drawn based on the differences observed between the two classes. Data analysis began with tests for normality, homogeneity, and hypothesis testing.

## RESULTS

### Improvement in Students' Scientific Literacy Skills

The data collected from the research on students' scientific literacy skills were measured using five essay test questions. These data include the results from the pretest, posttest, and N-Gain scores for both the experimental and control classes. The research data from the experimental and control classes are presented in Table 1.

Table 1. Descriptive Test Results for Pre-test and Post-test in the Experimental and Control Classes

| Class | Test Type | Score Range | Mean ($\bar{x}$) | Standard Deviation (Sd) | Ideal Maximum Score (SMI) |
|---|---|---|---|---|---|
| Experiment | Pre-Test | 3 - 16 | 8 | 3.227 | 20 |
| | Post-Test | 13 - 20 | 17 | 2.215 | |
| Control | Pre-Test | 4 - 13 | 7 | 2.377 | |
| | Post-Test | 6 - 18 | 12 | 2.756 | |

Table 1 shows that the maximum score achieved by both the experimental and control classes was 20. The pretest average scores in the experimental and control classes were not significantly different, indicating that both classes had similar levels of scientific literacy skills at the outset. Specifically, the average pretest score for the experimental class was 8, while the control class had an average score of 7. The average posttest score for the experimental class was 17, compared to 12 for the control class.

Inferential statistical analysis was then conducted on the pretest and posttest data for both the experimental and control classes, as shown in Table 2.

Table 2. Inferential Statistics for Pretest and Posttest Data

| Test Type | Pretest | Posttest |
|---|---|---|
| | Experimental | Control |
| Normality | 0.200 > 0.05 | 0.108 > 0.05 |
| Homogeneity | 0.171 > 0.05 | 0.268 > 0.05 |
| Independent Sample t-test | 0.355 > 0.05 | 0.000 < 0.05 |

Table 2 shows the results of the normality test (Kolmogorov-Smirnov) with a significance level of 5% or 0.05. The pretest and posttest data for both the experimental and control classes were normally distributed, as indicated by sig. values > 0.05. The homogeneity test results showed

that both classes had homogeneous variances, with sig. values > 0.05. The Independent Sample t-test for the pretest data in both classes revealed no significant difference in the average scores, with a sig. value > 0.05, indicating that the initial scientific literacy skills of the students were similar and relatively evenly distributed. However, the posttest data showed a significant difference between the two classes, with a sig. value < 0.05, indicating that the experimental class had a higher average score compared to the control class.

To determine whether the improvement in students' scientific literacy skills using the STEM approach assisted by Assemblr Edu was better than that of students using the Scientific approach, the researcher conducted an N-Gain analysis using SPSS version 24.0 with the data collected during the study. The criteria for determining students' scientific literacy skills (Raharjo, 2019) are presented in Table 3.

Table 3. N-Gain Criteria

| Interval | Category |
|---|---|
| g ≥ 0,70 | High |
| 0,30 < g ≤ 0,70 | Medium |
| g ≤ 0,30 | Low |

The N-Gain analysis of students' scientific literacy skills in the experimental and control classes is presented in Table 4.

Table 4. N-Gain Values for Students' Scientific Literacy Skills

| Class | N-Gain | Category |
|---|---|---|
| Experiment | 0.74 | High |
| Control | 0.66 | Medium |

Table 4 shows that the average N-Gain score for the experimental class was 0.74 (High category), while the control class had an average N-Gain score of 0.66 (Medium category). These N-Gain scores indicate that the experimental class, which used the STEM approach assisted by Assemblr Edu, achieved a higher N-Gain score compared to the control class, which used the Scientific approach.

Subsequent inferential statistical analysis of the N-Gain data for the experimental and control classes is presented in Table 5.

Table 5. Inferential Statistics for N-Gain Data

| Test Type | N-Gain | |
|---|---|---|
| | Experimental | Control |
| Normality | 0,200 > 0,05 | 0,200 > 0,05 |
| Homogeneity | 0,268 > 0,05 | |
| Independent Sample t-test | 0,000 < 0,05 | |

Table 5 shows that the N-Gain data for both classes were normally distributed, with sig. values > 0.05. The homogeneity test results indicated that both classes had homogeneous variances, with a sig. value > 0.05. The Independent Sample t-test for the N-Gain data showed a sig. value < 0.05, indicating that the improvement in scientific literacy skills among students using the STEM approach assisted by Assemblr Edu was significantly better than that of students using the Scientific approach.

**The Influence of the STEM Approach Assisted by Assemblr Edu on Students' Scientific Literacy Skills**

The STEM approach assisted by Assemblr Edu has shown a significant impact on students' scientific literacy skills, as evidenced by the average posttest scores of students in the experimental

class. The following is the result of a simple linear regression calculation of the STEM approach assisted by Assemblr Edu on scientific literacy skills.

Table 6. Results of the Constant and Coefficient Tests for the Regression Equation

| Model | Unstandardized Coefficients | |
|---|---|---|
| | B | Std. Error |
| Constant | 12,633 $\alpha$ | 0,697 |
| Pretest | 0,500 $\beta$ | 0,081 |

(Source: Research, 2024)

Based on the calculation results in Table 6, the simple linear regression equation is as follows: $\hat{Y} = 12{,}633 + 0{,}500X$. From this equation, it is known that the constant value (α) is 12.633, and the regression coefficient (β) is 0.500 with a positive sign. This indicates that the implementation of the STEM approach assisted by Assemblr Edu has a positive effect on improving students' scientific literacy skills, with an increase of 0.500.

Table 7. Regression Significance Test Results

| Test | P-value | Significant (α) | Explanantion |
|---|---|---|---|
| Regression | 0,000 | 0,05 | $H_1$ accepted |

(Source: Research, 2024)

Table 7 shows a p-value of < 0.000, which is less than 0.05. Therefore, $H_1$ is accepted, meaning that there is a significant influence of the STEM approach assisted by Assemblr Edu on students' scientific literacy skills.

To measure this influence, the coefficient of determination ($R^2$) was calculated using SPSS version 24.0. The results showed that the $R^2$ value is 0.576. The coefficient of determination was then calculated using the following formula.

Table 8. Determination Coefficient Test Results for the STEM Approach Assisted by Assemblr Edu on Students' Scientific Literacy Skills

| R | R Square | Std. Error of the Estimate |
|---|---|---|
| 0,759 | 0,576 | 1,407 |

Table 8 shows that the influence of the STEM approach assisted by Assemblr Edu on students' scientific literacy skills, as indicated by the R Square value, is 57.6%. Based on Table 8, it can be seen that the determination coefficient test results show an R Square value of 0.576. Next, the determination coefficient (D) is calculated using the following formula:

$$D = R^2 \times 100\% = 0.576 \times 100\% = 57.6\%$$

From the calculation above, the determination coefficient (D) is 57.6%, which means that the implementation of the STEM approach assisted by Assemblr Edu has a 57.6% influence on improving students' scientific literacy skills. Consequently, the influence of other factors on the improvement of scientific literacy skills is 100% - 57.6% = 42.4%.

## DISCUSSION

### Improvement in Students' Scientific Literacy Skills

Table 1 presents the research activities and data processing results that have been conducted. The average pretest scores indicate that the results for both classes were almost equal, meaning that both classes had similar levels of scientific literacy skills. According to the posttest results, the experimental class achieved better scores compared to the control class. Furthermore, Table 2 shows that the inferential analysis of the pretest and posttest data was normally distributed

and homogeneous with a significance threshold of 0.05. A t-test was conducted using SPSS version 24.0. After testing the hypothesis, it was found that the STEM approach assisted by Assemblr Edu had a significant effect on students' scientific literacy skills.

The improvement in N-Gain of students' scientific literacy skills can be observed in Tables 4 and 5. The N-Gain results for the experimental class were categorized as high, while those for the control class were categorized as medium. This indicates that the improvement in students' scientific literacy skills using the STEM approach assisted by Assemblr Edu was better compared to students using the Scientific approach.

The reason for the significant improvement in scientific literacy skills in the experimental class is that the STEM approach assisted by Assemblr Edu encourages students to actively participate in every step of the learning process. This begins with identifying problems posed by the teacher through questions, then imagining and determining solutions, planning and creating products to solve problems, and finally improving the product if there are any shortcomings.

The STEM approach not only teaches students how to use their knowledge to solve problems but also requires them to apply their skills to address real-world issues (Rohmah et al., 2019). The inferential analysis in Table 5 shows that the improvement in scientific literacy skills for students using the STEM approach assisted by Assemblr Edu was better than for those using the Scientific approach. Based on the descriptive and inferential analysis in this study, learning with the STEM approach assisted by Assemblr Edu was more effective than the Scientific approach in enhancing students' scientific literacy skills.

**The Influence of the STEM Approach Assisted by Assemblr Edu on Students' Scientific Literacy Skills**

The influence of the STEM approach assisted by Assemblr Edu, as analyzed inferentially using simple linear regression, can be seen in Table 6, where the regression equation is obtained as $\hat{Y} = 12.633 + 0.500X$. With a constant value of 12.633 and a regression coefficient of 0.500, the constant value of scientific literacy skills is 12.633 if there is no intervention using the STEM approach assisted by Assemblr Edu.

The regression coefficient means that for every additional intervention, the scientific literacy skills score will increase by 0.500. Based on Table 7, the coefficient of determination from the regression test indicates that the STEM approach assisted by Assemblr Edu accounts for 57.6% of the variation in students' scientific literacy skills. This result is supported by the fact that the application of the STEM approach has a significant impact on the scientific literacy skills of elementary school students (Amiruddin et al., 2021).

Learning with the STEM approach assisted by Assemblr Edu was applied to the topics of changes in energy and alternative energy sources. The STEM approach was implemented through five stages in each session: ask, imagine, plan, create, and improve.

The application of these five stages in the STEM approach assisted by Assemblr Edu has been proven to impact students' scientific literacy skills, as evidenced by the inferential analysis using simple linear regression. The results are clearly visible in Tables 6 and 7, where the integration of the STEM approach assisted by Assemblr Edu shows a significant correlation and influence on students' scientific literacy skills.

This finding is further supported by the coefficient of determination test results presented in Table 8. Learning through the application of the STEM approach assisted by Assemblr Edu showed an influence of 57.6% on students' scientific literacy skills. This indicates that the use of the STEM approach with Assemblr Edu facilitated a smoother understanding of the material related to energy changes and alternative energy sources over three sessions. Meanwhile, the remaining 42.4% influence comes from other factors that impact the integration of the STEM approach assisted by Assemblr Edu with students' scientific literacy skills. One such factor is the challenge of selecting appropriate technological devices for using the Assemblr Edu application, which can limit the available time. To address this issue, researchers utilized LCD projectors and barcodes. Additionally, time constraints were another challenge in its implementation, highlighting the need to optimize the allocation of time for practical activities during the learning process.

Learning using the STEM approach assisted by Assemblr Edu can positively influence the scientific literacy skills of elementary school students. This is further supported by the application of the STEM approach, which can help students develop 21st-century skills (Jackson et al., 2021). The application of STEM learning is capable of creating a learning environment that advances students in problem-solving and enhances their 21st-century skills (Wiryanto et al., 2023). This is evidenced by the use of Assemblr Edu media in Natural Science learning with the STEM approach.

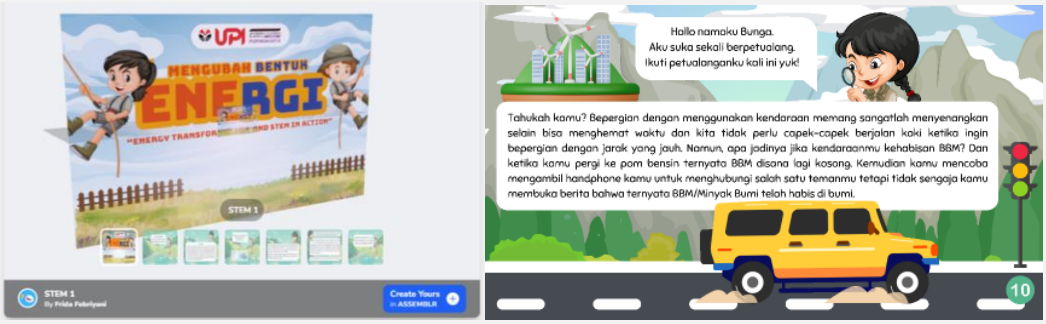

Figure 1. Assemblr Edu Media Display.

Based on Figure 1, the stages of learning in the experimental class began with student interaction by identifying problems using the Assemblr Edu application. This platform presents issues related to energy changes and alternative energy sources, with a barcode (Ask) for students to observe. One of the student activities in identifying problems using Assemblr Edu is presented in Figure 2.

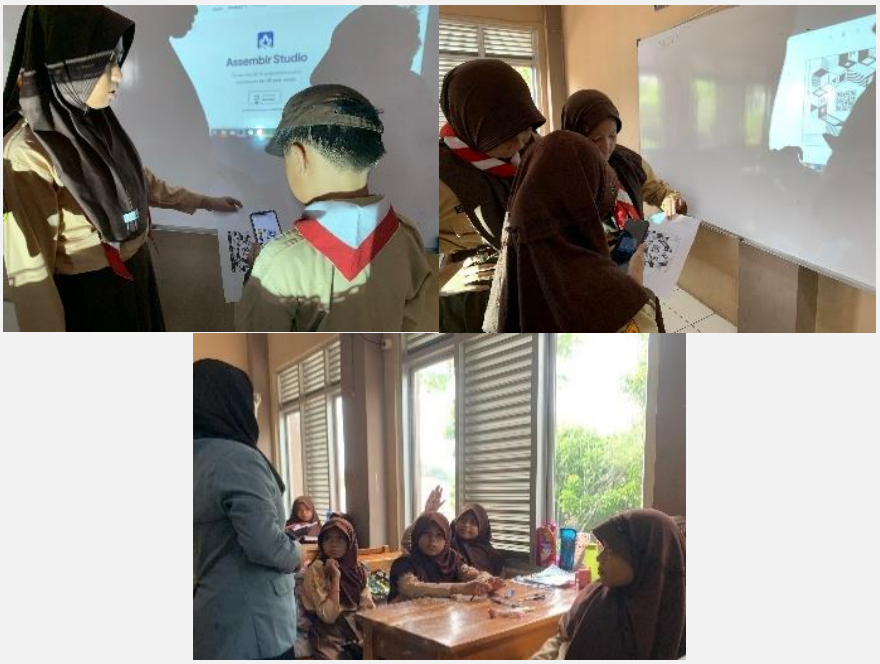

Figure 2. Activities in the (Ask) Stage Using Assemblr Edu.

Based on Figure 2, during the learning process with the STEM approach, the teacher displayed Assemblr Edu media, and many students expressed their arguments based on their observations of Assemblr Edu after it was displayed. Consistent with Muhanditsah (2023), the STEM approach was shown to improve elementary school students' scientific literacy skills.

Furthermore, STEM activities can positively impact students' understanding of elements in experimental design. The learning activities in the imagine and plan stages can be seen in Figure 3.

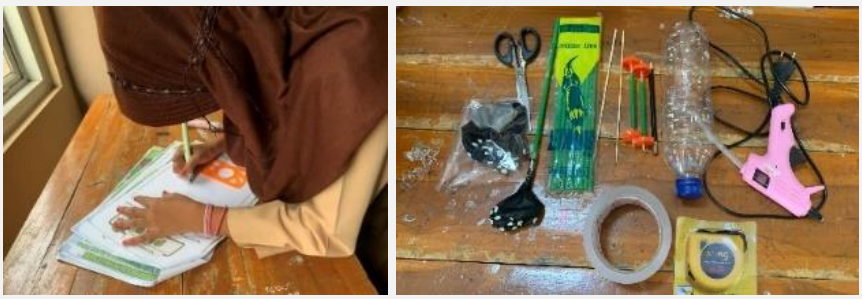

Figure 3. Learning Activities in the Imagine and Plan Stages.

From Figure 3, the practical STEM learning integrated with Assemblr Edu media is seen as impactful. This is reinforced by the enthusiasm of students in conducting experiments and encouraging them to collaborate. This is further supported by the engineering process, according to Nuraeni (2020), which includes activities such as identifying problems, designing solutions, constructing or creating solutions to problems, and testing. Testing may involve multiple trials, as engineering often encounters failures in finding the right solution. The learning activities in the improve stage can be seen in Figures 4, 5, and 6.

Figure 4. Activities and Products of Waterwheel in the Experimental Class.

Figure 5. Activities and Products of Solar Oven in the Experimental Class.

Based on the images above, student discussion and evaluation activities became more active in recording observations and presenting their findings, which contributed to improving students' skills. Furthermore, STEM practical activities positively influenced the level of communication, as evidenced by more effective discussions and communication between students, their peers, and their teachers. According to research conducted by Adeosun & Shanu (2022),

STEM learning encourages students to communicate, collaborate, think critically, and creatively solve problems in science and mathematics.

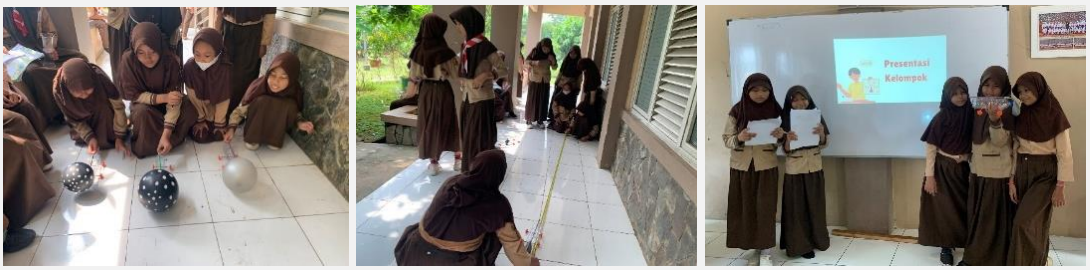


Figure 6. Activities and Products of Wind-Powered Car in the Experimental Class.

Based on these results, it can be concluded that researchers can apply the STEM approach assisted by Assemblr Edu to enhance and develop students' scientific literacy skills, given the students' enthusiasm and the effective management of available time, allowing all five stages of the STEM approach to be completed in each session.

## CONCLUSION

Based on the data analysis, findings, and discussion presented, several conclusions can be drawn. There is a positive influence of 57.6% from the application of the STEM approach assisted by Assemblr Edu on students' scientific literacy skills in Natural Science learning at the elementary school level. Additionally, the improvement in scientific literacy skills among elementary school students who received the STEM approach assisted by Assemblr Edu was better than that of students who received conventional teaching methods, as assessed overall. The N-Gain test results for the experimental class using the STEM approach assisted by Assemblr Edu fall into the high category, with a score of 0.74.

Learning using the STEM approach assisted by Assemblr Edu can be applied as an effort to train and enhance students' scientific literacy skills. It can be implemented in elementary schools to train fourth-grade students' scientific literacy skills in Natural Science subjects, particularly on the topics of energy changes and alternative energy sources. This learning approach can be considered successful in improving students' scientific literacy skills if educators are well-prepared with all necessary facilities and if students actively participate in the learning process. To achieve better improvement in students' scientific literacy skills, the use of Assemblr Edu as a learning medium requires supportive facilities and technology for effective classroom implementation.

Based on the research results, the application of the STEM approach assisted by Assemblr Edu can be considered an alternative solution for enhancing students' scientific literacy skills. The influence on students' scientific literacy skills by 57.6% suggests the need for further research to explore the remaining 42.4% influenced by other factors. When using Assemblr Edu as a learning medium, it is important to balance the time of implementation with active student participation to achieve better scientific literacy skills. This study used three indicators of students' scientific literacy skills, so future research is recommended to explore additional indicators. The study focused on developing instruments to measure scientific literacy skills in the competency aspect, and it is recommended that future studies develop instruments to measure scientific literacy skills in other aspects, such as knowledge.

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