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The Effect Of The Stem Approach Aided By The Assemblr Edu Media On The Learning Outcomes Of Grade V Students

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Abstract

This study aims to investigate the effect of a STEM approach assisted by Augmented Reality (AR)-based Assemblr Edu media on students' learning outcomes. The research applied a quantitative method using a pre-experimental design with a one-group pretest–posttest format. The participants were 23 fifth-grade students selected through a saturated sampling technique. The instrument used was a 20-item multiple-choice test that had been validated and showed high reliability with a Cronbach's Alpha value of 0.877. Data were analyzed using the Shapiro–Wilk normality test and a paired sample t-test with SPSS version 25. The findings revealed that the average pretest score increased from 53.91 to 75.43 in the posttest, indicating an improvement of 21.52 points. The interactive AR visualization helped students understand abstract IPAS concepts more concretely and meaningfully. The significance value obtained was 0.000 (< 0.05), H_0 was rejected and H_a was accepted, so which means that there is a significant effect of the STEM approach assisted by Assemblr Edu media on students' learning outcomes of grade V of SDN 1 Ella Hilir

Keywords: STEM approach, Augmented Reality, Assemblr EDU, learning outcomes

1. Introduction

Education should create engaging learning conditions and apply suitable methods so students can develop their potential and become a competent generation in attitudes, knowledge, and skills (Kurniawan et al., 2024). Educational success is not only measured by final scores but also by meaningful learning experiences that help students grow academically and personally.

The use of technology in education has shifted conventional instruction into more interactive and learner-centered practices. Digital media help students understand difficult concepts through visual representation and simulation (Haleem et al., 2022). In this regard, immersive technology such as augmented reality (AR) has gained increasing attention. Previous studies reported that AR can support learning by combining virtual objects with real environments, allowing abstract concepts to become clearer and easier to learn(Singh et al., 2022)

One approach frequently applied to improve learning quality is STEM (Science, Technology, Engineering, and Mathematics). This approach combines several disciplines and encourages learners to solve real-life problems while developing critical thinking, creativity, collaboration, and communication skills (English, 2016) In addition, combining immersive technology with STEM activities creates richer learning experiences. The use of AR and VR in STEM learning can help students observe scientific phenomena and strengthen conceptual understanding (Garzón et al., 2019).

Immersive learning environments, such as virtual field trips, also improve student learning experiences because they present contextual situations that are difficult to obtain through traditional teaching (Cheng & Tsai, 2019). The application of extended reality (XR) in STEM education also plays an important role in helping students explore and understand complex concepts through visualization


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and interaction (Zhang et al., 2024). Therefore, integrating STEM approaches with digital media such as Assemblr Edu is considered an effective strategy to improve students' learning outcomes.

Additionally, research shows that technology-assisted STEM learning improves student academic achievement, motivation, and engagement through an active learning environment (Margot & Kettler, 2019) This shows that the integration of technology in STEM supports learning outcomes and creates more interactive learning. The use of Assemblr Edu in this study is relevant to increase students' understanding and activeness.

At the elementary level, learning aims not only to achieve instructional objectives but also to build understanding, improve intellectual abilities, and foster persistence (Dian et al., 2023). Therefore, appropriate approaches and learning media are needed to support motivation, conceptual understanding, and higher-order thinking skills. STEM education has been widely recognized as an effective strategy to enhance students' critical thinking, creativity, and problem-solving skills (Sari et al., 2024).

STEM is a multidisciplinary learning approach that integrates Science, Technology, Engineering, and Mathematics to bridge the gap between education and real-world demands (Elva & Uhana, 2021). It encourages students to apply knowledge in an integrated and contextual manner (Kelley & Knowles, 2016). In this study, STEM learning is implemented through science, technology, engineering, and mathematics integration. Science involves students understanding IPAS concepts through interactive 3D exploration; technology is represented by the use of Assemblr Edu as a digital learning medium; engineering allows students to design simple projects based on their exploration; and mathematics involves calculating and analyzing experimental results.

The integration of the four STEM components in learning activities plays an important role in developing students' conceptual understanding and 21st-century skills (Kelley & Knowles, 2016). Science helps students understand scientific concepts and natural phenomena, technology supports digital-based learning experiences, engineering encourages students to design and solve problems creatively, while mathematics strengthens logical thinking and analytical skills. The integration of these four disciplines creates meaningful and contextual learning experiences that support active student participation and problem-solving abilities (Thibaut et al., 2018)

STEM-based learning has been proven to significantly improve learning outcomes, especially in developing problem-solving skills and interdisciplinary thinking (Solikha et al., 2025). It also fosters curiosity and active engagement, which leads to deeper conceptual understanding. However, challenges such as limited teacher readiness, time constraints, and the need for technological resources remain barriers in its implementation (Khodijah & Mulyaningsih, 2023)

Learning media play a crucial role in supporting effective learning processes (Septiana & Albar, 2024). Educational media have developed from conventional forms into digital and interactive tools. One recent innovation is augmented reality, which combines virtual objects with real environments and creates immersive experiences. Although still developing in Indonesia, AR has shown promising potential in education (Ginting & Tambunan, 2023).

Assemblr Edu is an interactive platform that facilitates engaging and collaborative learning through 3D and AR visualization. Students can explore complex concepts, such as the human respiratory system, through interactive simulations and animations (Salsabila et al., 2025). Previous research indicates that AR-based learning media are effective in improving students' cognitive learning outcomes and conceptual understanding (Padang et al., 2022) Additionally, Assemblr Edu helps students better observe and understand learning materials while increasing their motivation and engagement (Israwanty et al., 2025)

The findings of previous studies suggest that integrating STEM with immersive technologies creates more interactive and relevant learning experiences, enabling students to understand abstract concepts through visualization and simulation (Tene et al., 2024). This is further supported by research showing that XR technologies significantly enhance learning outcomes, particularly in complex subject areas (Zhang et al., 2024)

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Learning outcomes are the ultimate goal of the learning process and reflect students' mastery of knowledge and skills after instruction (Dian et al., 2023). They are influenced by various factors, including teaching methods, learning media, and student engagement (Mawardhani et al., 2023).

Based on preliminary observations conducted at SD Negeri 1 Ella Hilir, several challenges were identified in the learning process, particularly in IPAS subjects. Students tend to lack focus, show low engagement, and experience difficulties in understanding concepts. The learning process is still teacher-centered, and the use of innovative media is limited, resulting in suboptimal learning outcomes, with many students scoring below the minimum mastery criterion (KKM) of 65.

Therefore, this study applies a STEM approach assisted by Assemblr Edu media as an alternative solution to create meaningful, interesting, and interactive learning experiences. This approach is expected to improve motivation, conceptual understanding, and student learning outcomes. The purpose of this study is to examine the effect of the STEM approach assisted by Assemblr Edu media on the learning outcomes of fifth-grade students at SDN 1 Ella Hilir.

2. Methods

The research method used in this study is quantitative research (Sugiyono, 2022). The type of research uses the Pre-Experimental Design type with the One-Group Pretest-Posttest Design type. The population in this study is all students in grade V of SDN 1 Ella Hilir for the 2025/2026 Academic Year with a sample of 1 class of 23 students, of which 11 female students and 12 male students. The sampling technique chosen is saturated sampling. According to (Sugiyono, 2022), saturated sampling is a sample determination technique when all members of the population are used as samples. The independent variable is the media-assisted STEM approach of Assemblr Edu while the bound variable in this research problem is the cognitive learning outcomes of students. The data collection technique used in this study is a test sheet consisting of pretest and postest with 20 multiple-choice questions.

During the implementation process, students used smartphones provided by the school or brought personally under teacher supervision. Students were guided to access the Assemblr Edu application, scan the prepared AR markers, and observe three-dimensional visualizations related to the human respiratory system material. After observing the AR objects, students participated in STEM-based learning activities, including group discussions, simple problem-solving tasks, and project-based exploration related to the topic. The teacher guided students throughout the learning activities to ensure proper use of the devices and applications.

The data analysis technique in this study uses a construct test to determine the validity of the student learning outcome test instrument. The internal consistency test was chosen because it can measure the extent to which the items in the instrument produce a consistent score. The technique used in this study is Croncbach's Alpha. And the normality test was carried out with the help of SPSS or Statistical Package for the Social Sciences version 25, the normality test was carried out to determine whether the prestest and postest data were spread normally. For normality tests with samples below 30, it is recommended to use the Shapiro-wilk test because it is more sensitive and more suitable for small sample sizes. In this hypothesis test, the author used the paired sample t test to see the effect of treatment. If the data is distributed normally, a paired t test (paired sample t test) is carried out to see the effect of the significance of treatment on the pretest and posttest scores.

3. Results and Discussion

3.1.1. Research Results

The construct validity test was carried out to ensure the suitability of the question items with the measured construct, namely the understanding of the concept of the human respiratory system in the We Breathe material through STEM-based learning assisted by Assemblr Edu media with the question items prepared based on the learning indicato. The results of the validity test conducted at SDN 11 Nanga Pinoh showed that of the 25 questions tested, there were 20 questions that were declared valid and 5 questions that were invalid so that they were not used in the research. The validity test of the

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instrument was carried out using Pearson Product Moment correlation with the help of SPSS software version 25. Based on the test results, all question items had a positive item-total correlation coefficient and met the acceptance criteria at a significance level of 0.05, with a correlation value ranging from 0.433–0.676 (Sig. < 0.05). Thus, all question items are declared valid constructively. The reliability test of the instrument was carried out using Cronbach's Alpha coefficient. The test results showed a Cronbach's Alpha value of 0.877, which indicated that the instrument had high reliability. Based on the results of the validity and reliability test, the learning outcome test instrument was declared feasible for use in this study.

Tabel 1. Reliability

Statistics

Cronbach's Alpha	N of Items
.877	20

3.1.2 Normality Test

The normality test aims to test whether the data of dependent and independent variables has a normal distribution or not. The data used are pretest and posttest data on student learning outcomes. The data in this study using the Shapiro–Wilk normality test showed that the data was distributed

normally, because the number of samples was less than 50. By using SPSS software version 25.

Tabel 2. Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
PRETEST	.121	23	.200*	.960	23	.467
POSTEST	.115	23	.200*	.967	23	.616

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Based on table 2. The results of the analysis showed that the significance value of Shapiro–Wilk for pretest data was 0.467 and posttest data was 0.616. The significance value of the two data is greater than 0.05 (Sig. > 0.05), so that the pretest and posttest data are declared to be normally distributed. Thus, the data is eligible for analysis using parametric statistical tests.

3.1 .3 paired sample t-test

The paired sample t-test was carried out to find out the differences in student learning outcomes before and after the implementation of STEM-based learning assisted by Assemblr EDU media on the material We Breathe. The analysis was carried out on the pretest and posttest scores of 23 students.

Tabel 3. Paired Samples Test

Paired Differences	t

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				95% Confidence Interval of the Difference				
	mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	PRETEST - POSTEST	-21.522	8.317	1.734	-25.118	-17.925	-12.410	22	.000

The results of the analysis showed a value of t = −12.410 with df = 22 and Sig. (2-tailed) = 0.000 (< 0.05). The average difference between pretest and posttest scores was −21.522, with a 95% confidence interval in the range of −25.118 to −17.925. Because the significance value is 0.000 < 0.05, Ho is rejected and Ha is accepted. These results showed a significant difference between learning outcomes before and after treatment.

3.2 Discussion

This study aims to determine the effect of the STEM approach assisted by Assemblr Edu media on students' learning outcomes in the topic of the human respiratory system. Based on the results of the analysis, it was found that the STEM approach assisted by Assemblr Edu media had an effect on the learning outcomes of fifth-grade students at SDN 1 Ella Hilir.

The results of the study can be seen from the comparison between pretest and posttest scores. Before the treatment, the average student learning outcome was 53.91. After the implementation of STEM-based learning assisted by Assemblr Edu media, the average score increased to 75.43. This indicates an increase of 21.52 points. These findings show that the STEM approach assisted by Assemblr Edu media has a positive impact on students' conceptual understanding.

Before conducting the hypothesis test, a normality test was performed using the Shapiro–Wilk test because the sample size was less than 50. The results showed that the significance value of the pretest was 0.467 and the posttest was 0.616, both greater than 0.05. Thus, the data were normally distributed, and the paired sample t-test was used to analyze the difference. The results of the paired sample t-test showed that the value of Sig. (2-tailed) = 0.000 (< 0.05) with t = −12.410 at df = 22, indicating a difference in learning outcomes before and after treatment.

The implementation of STEM-based learning assisted by Assemblr Edu media shows a consistent contribution in improving the quality of the learning process and outcomes. The integration of STEM with interactive digital media such as Assemblr Edu helps students understand concepts more concretely through three-dimensional visualization, making learning more engaging and meaningful. This finding is in line with previous research which states that Assemblr Edu-assisted learning media is effective and practical for use in learning activities (Lestari et al., 2023). The application of these media has been proven to be able to improve student learning outcomes, both in terms of knowledge and attitudes. The results of the research conducted by (Dewi et al., 2022) stated that learning through the use of the Assemblr Edu learning media application can improve student learning outcomes.

Integrated STEM instruction has been shown to enhance students' problem-solving ability, creativity, and collaboration skills. (Thibaut et al., 2018) stated that effective STEM learning combines problem-centered learning, inquiry-based learning, design-based learning, and cooperative learning. These principles are in line with the learning activities implemented in this study, where students were actively engaged in exploring and discussing respiratory system concepts.

Besides improving cognitive learning outcomes, the implementation of STEM learning assisted by Augmented Reality-based Assemblr Edu media also increased students' motivation and psychological engagement during the learning process. Students showed greater enthusiasm, curiosity, and participation when interacting with three-dimensional AR visualizations. The immersive learning


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environment encouraged students to become more actively involved in observing, discussing, and exploring learning materials. This finding is supported by previous studies showing that Augmented Reality can increase students' motivation, engagement, and interest in STEM learning activities (Ibáñez & Delgado-Kloos, 2018)

Augmented reality (AR) technology provides interactive learning experiences by presenting three-dimensional visualizations that make abstract concepts easier to understand. This technology has been proven to increase student engagement and conceptual understanding (Akçayır & Akçayır, 2017). The use of Augmented Reality technology such as Assemblr Edu offers an interactive visual experience, so that students can better understand abstract ideas in a more realistic way. In addition, immersive technology can improve the learning process by making it more interactive (Radianti et al., 2020).

Furthermore, the use of Augmented Reality (AR)-based three-dimensional visualization in Assemblr Edu can also be explained through Cognitive Load Theory. Recent studies explain that learning media with clear visualization and interactive digital design can reduce students' extraneous cognitive load during the learning process, allowing learners to focus more effectively on understanding concepts (Skulmowski & Xu, 2022). In this study, the respiratory system material, which is considered abstract for elementary school students, became more concrete through interactive 3D visualization. Students were able to observe the organs and breathing processes directly through AR features, making the learning process easier to understand compared to conventional explanation methods. This condition helped students focus their attention on understanding concepts rather than imagining abstract objects mentally. As a result, students experienced better conceptual understanding, which contributed to the significant increase in learning outcomes shown by the 21.52-point improvement between pretest and posttest scores.

This result is also consistent with the findings of (Zulmi et al., 2026), who reported that the use of Assemblr Edu in primary science education creates more meaningful learning experiences and improves students' motivation and conceptual understanding. Therefore, the use of Assemblr Edu in this study helped students learn the human respiratory system more effectively through immersive visualization.

In this study, the use of Assemblr Edu media helped the students to visualize the human respiratory system through three-dimensional images, which made it easier for them to understand difficult concepts. These findings are reinforced by previous research showing that the use of Assemblr Edu learning media is able to improve student learning achievement (Faozi et al., 2025). STEM-based learning encourages students to think critically and solve real-world problems, which contributes to improved learning outcomes (Sailer & Homner, 2020).

In terms of the STEM approach combined with the Assemblr EDU media, it has a positive impact on student learning outcomes, both in cognitive and affective aspects. In addition to improving understanding of concepts, the application also supports the development of 21st-century skills, such as critical thinking, creativity, collaboration, and communication, which are important in the face of global challenges (Bybee, 2018)

4. Conclusion

Based on the results of research and data analysis, it can be concluded that the STEM approach assisted by the EDU Assemblr media has an effect on the learning outcomes of IPAS students in grade V of SDN 1 Ella Hilir on the material of the respiratory system (We Breathe). This is evidenced by an increase in the average student score from 53.91 in the pretest to 75.43 in the posttest with a difference of 21.52 points. The results of the paired sample t-test showed a significance value of 0.000 (< 0.05), which indicated a difference in learning outcomes before and after treatment.

The application of STEM approaches that are integrated with Augmented Reality-based learning media through Assemblr EDU is able to increase student involvement in the learning process, help visualize concepts more concretely, and support deeper understanding. Thus, this approach can be an

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alternative innovative learning strategy to improve the learning outcomes of science in elementary schools.

However, the implementation of STEM learning assisted by Assemblr Edu media also requires adequate technological infrastructure. Schools need to provide smartphones or devices that support Augmented Reality (AR) features, stable internet access, and proper technical preparation before learning activities are carried out. Teachers also need to guide students during the use of the application to avoid technical difficulties during the learning process. Therefore, infrastructure readiness and technical support are important considerations for schools or educators who intend to implement similar learning approaches.

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