

The Influence of Simple Hologram Media Based on Problem-Based Learning on Science Learning Outcomes

 <https://doi.org/10.31004/jele.v11i5.2787>

*Fitalia Br Sembiring, Anton Sitepu, Irmina Pinem, Regina Sipayung, Joen Parningotan
Purba^{abcde}

¹²³⁴⁵Pendidikan Guru Sekolah Dasar Universitas Katolik Santo Thomas Medan, Indonesia

Corresponding Author: fitaliasembiring21@gmail.com

ABSTRACT

This study aimed to determine the effect of using simple hologram media based on the Problem Based Learning model on the science learning outcomes of fifth-grade students at SD Negeri 060971 Kemenangan Tani in the 2025/2026 academic year. The study employed a quantitative approach using a Pre-Experimental Design with a One-Group Pretest-Posttest design. The sample consisted of 25 students selected through purposive sampling. Data were collected using a learning achievement test and analyzed through normality, correlation, and t-test analyses. The results showed that the students' mean score increased from 58.2 on the pretest to 85.6 on the posttest after the treatment. The normality test indicated that the data were normally distributed ($0.087 \leq 0.173$). The correlation test showed a very strong relationship ($r = 0.843 > 0.367$). Furthermore, the t-test result ($7.511 > 2.063$) indicated a significant positive effect on students' science learning outcomes regarding the Solar System topic.

Keywords: *Simple Hologram Media, Problem Based Learning, Learning on Science Learning Outcome*

Article History:

Received 16th June 2026

Accepted 11th October 2026

Published 18th October 2026



INTRODUCTION

Education plays an essential role in developing students' knowledge, skills, attitudes, and character to prepare them for participation in society. As science and technology continue to advance, educational practices need to adapt by incorporating innovative approaches that support meaningful learning experiences. In science education, students should not merely memorize scientific information but also develop the ability to investigate phenomena, construct explanations, and apply scientific knowledge to real-life situations. Council (2012) emphasizes that science education should integrate scientific practices, crosscutting concepts, and core scientific ideas to strengthen students' understanding. Furthermore, Abdulrahman et al. (2020) explain that multimedia tools, including animation and three-dimensional media, can support teaching and learning when they are appropriately designed for the subject matter and learners' needs. Therefore, teachers need to provide learning experiences that encourage active participation, scientific inquiry, and conceptual understanding.

Based on observations and interviews with fifth-grade teachers at SD Negeri 060971 Kemenangan Tani, several problems were identified in the science learning process. Classroom instruction remains dominated by lectures and teacher-centered activities, while instructional media are primarily limited to textbooks, whiteboards, and conventional pictures. Although technological facilities are available at the school, their use in classroom instruction has not been optimized. Consequently, students tend to participate passively, demonstrate limited enthusiasm, and experience difficulties understanding abstract scientific concepts, particularly the Solar System. These conditions are consistent with the findings of Ningsih et al. (2025), who reported that conventional textbook-based instruction and limited interactive media can constrain student engagement and conceptual understanding in

elementary science learning. In addition, [Hoon & Shaharuddin \(2019\)](#) found that three-dimensional hologram animation could attract primary school students' attention and support learning effectiveness. Similarly, [Nurrafiah et al. \(2023\)](#) identified a significant relationship between pyramid hologram media and student activity in elementary science learning. Research by [Zakirman et al. \(2022\)](#) also demonstrated the potential of animation-based instructional media to improve elementary students' understanding of science concepts. These findings support the need to explore more interactive media to address the learning difficulties identified at the research site. Furthermore, daily assessment records at the research site indicate that 48% of students have not achieved the learning objectives established by the school, highlighting the need for more effective instructional strategies.

The observed conditions indicate a gap between the expected implementation of science learning and the practices currently used in the classroom. Ideally, science instruction should encourage students to explore questions, investigate scientific phenomena, exchange ideas, and construct their own understanding rather than rely exclusively on explanations provided by teachers. [Mayer \(2008\)](#) explains that multimedia instruction should be designed according to evidence-based principles of learning so that verbal and visual information can support meaningful knowledge construction. When learning activities rely heavily on verbal explanations and static illustrations, students may have limited opportunities to explore complex relationships between scientific objects and phenomena. Therefore, improving science learning requires not only the introduction of new instructional media but also the integration of learning strategies that encourage students to actively process information and participate in knowledge construction. One potential approach is Problem-Based Learning (PBL), which engages students in investigating problems, discussing possible explanations, and developing solutions. [Dağyar & Demirel \(2015\)](#), through a meta-analysis, reported that PBL can positively influence academic achievement compared with traditional instruction. Accordingly, integrating simple hologram media with PBL may provide an opportunity to visualize abstract Solar System concepts while encouraging students to engage in problem-solving activities and construct a deeper understanding of the material.

One possible alternative for addressing these challenges is the use of simple hologram media to visualize scientific objects in three-dimensional forms. This approach is particularly relevant to Solar System material because planets, their relative positions, and their spatial relationships are difficult to observe directly in everyday classroom settings. [Hoon & Shaharuddin \(2019\)](#) investigated three-dimensional hologram animation among primary school students and reported that the media attracted students' attention and supported learning, with 72% of participants obtaining higher post-test scores than pre-test scores. Similarly, [Nurrafiah et al. \(2023\)](#) examined the relationship between pyramid hologram media and student activities in elementary science learning. These studies provide a basis for considering hologram media as an alternative to conventional visual materials. Nevertheless, the effectiveness of simple holograms should be evaluated in the specific context of Solar System learning rather than assumed to occur automatically.

Visual instructional media can help students connect abstract scientific information with representations that are easier to observe and interpret. In elementary science education, animations, simulations, and interactive multimedia can provide alternative ways to represent objects and processes that cannot be directly experienced in the classroom. [Zakirman et al. \(2022\)](#), for example, investigated electronic animation media for improving elementary students' understanding of science learning and found a significant difference in learning outcomes before and after its implementation. This evidence supports the use of visual media as a potential means of improving students' understanding of scientific concepts. In the present study, simple hologram media are intended to make Solar System objects more visually accessible, stimulate students' curiosity, and provide opportunities to discuss the relationships among celestial bodies. The media will serve as a learning aid rather than a replacement for teacher explanations, questioning, and classroom interaction.

In addition to selecting appropriate instructional media, teachers need a learning model that actively involves students in the learning process. Problem-Based Learning (PBL)

provides opportunities for students to investigate problems, identify relevant information, discuss possible explanations, and develop solutions collaboratively. Dağyar & Demirel (2015), through a meta-analysis of research comparing PBL with traditional instruction, reported that PBL can influence academic achievement, although its effectiveness may vary according to the educational context and implementation. In elementary science learning, PBL can be implemented by presenting students with questions related to observable or everyday phenomena and encouraging them to investigate possible explanations. For Solar System material, students may be asked to explain why planets occupy different positions or how the Sun, Earth, and other planets relate to one another. Such activities can encourage students to connect the visual information provided by hologram media with scientific reasoning and problem-solving.

Combining simple hologram media with PBL offers a potential instructional approach that integrates visual representation with active inquiry. The hologram provides students with a three-dimensional representation of Solar System objects, while PBL organizes learning activities around questions, investigation, discussion, and solution development. Uluçınar (2023), in a meta-analytical study of 55 experimental studies, found that PBL had a high effect on academic achievement in science compared with traditional instruction. Similarly, Noviana et al. (2022) examined PBL assisted by instructional videos in elementary science learning, providing a relevant example of combining instructional media with a problem-oriented learning model. These findings support the rationale for integrating media and pedagogy rather than using visual technology in isolation. However, the combined use of simple holograms and PBL for Solar System learning at SD Negeri 060971 Kemenangan Tani remains an empirical question that requires direct investigation.

Based on the problems identified and the supporting literature, this study proposes the use of simple hologram media integrated with the Problem-Based Learning (PBL) model to improve fifth-grade students' learning outcomes in Solar System material at SD Negeri 060971 Kemenangan Tani. Previous research has demonstrated the potential of interactive multimedia integrated with PBL to support learning in elementary education. For example, Ainullah et al. (2023) developed interactive learning multimedia based on PBL for fifth-grade students and reported improved learning outcomes. Similarly, Armadhani et al. (2025) found that PBL-based interactive science multimedia was feasible and effective in supporting students' understanding and critical thinking. A broader review by Khoirunnisa & Solihin (2026) also highlighted the relevance of interactive digital media in PBL-based elementary science instruction, while identifying implementation challenges such as limited infrastructure and teachers' digital competencies. Furthermore, Kristiana & Radia (2021) reported a substantial effect of PBL on elementary students' science learning outcomes in their meta-analysis, and Nugroho & Nugraha (2024) likewise found that PBL could positively influence science learning outcomes at the elementary level. Nevertheless, the present study focuses on integrating simple hologram media with PBL in the specific classroom context identified through preliminary observations. It will investigate whether this instructional combination improves students' learning outcomes while encouraging more active participation and deeper conceptual understanding. The findings are expected to provide practical information for teachers seeking accessible instructional innovations and contribute evidence regarding the application of simple hologram media within problem-based science instruction. Ultimately, the study aims to determine whether the proposed approach offers a meaningful improvement over the learning practices currently used at the school.

METHOD

Respondents

This study involved a sample group of fifth-grade students at UPT SD Negeri 060971 Kemenangan Tani in the 2025/2026 academic year. The sample was selected using a purposive sampling technique with a total of 25 students.

Instruments

The instrument used in this study was a science learning outcome test consisting of 30 multiple-choice questions on the Solar System, administered during the pretest and posttest. Before being used in the study, the instrument was tested for validity and reliability. Based on the results of the validity test on 29 students ($n=29$) with an r value of 0.367, the (30) test items were declared valid because the calculated r value was ≥ 0.367 . Furthermore, the reliability test using the Cronbach's Alpha coefficient showed a value of (0,843). Because the Cronbach's Alpha value was greater than 0.60 ($0,843 > 0.60$), the learning outcome test instrument was deemed reliable and suitable for use as a data collection tool in the study.

Procedures

The research design used was a Pre-Experimental Design with a One-Group Pre-Test-Post-Test Design. According to Sugiyono (2021:111) "experimental research is a quantitative method carried out by providing certain treatments to determine the effect of independent variables on dependent variables under controlled conditions." The research design involved administering an initial test (pre-test) before treatment and a final test (post-test) after treatment. The treatment given was the use of simple hologram media based on Problem-Based Learning on the topic of the Solar System. A comparison of pre-test and post-test results was used to determine the effect of media use on student learning outcomes.

Data analysis

Analisis data dalam penelitian ini dilakukan secara kuantitatif melalui uji validitas, uji reliabilitas, uji normalitas, uji koefisien korelasi, uji koefisien determinasi, dan uji t. Serangkaian uji tersebut digunakan untuk mengetahui kelayakan instrumen penelitian, mengukur hubungan antarvariabel, serta menguji hipotesis penelitian

FINDINGS AND DISCUSSION

Descriptive Analysis of Student Learning Outcomes

Pretest scores were taken before the use of simple hologram media based on the problem-based learning model began to determine students' initial abilities. Descriptive statistics showed an average pretest score of 58.2. After the treatment, the average posttest score increased to 85.6. This increase in descriptive scores served as the basis for further statistical testing.

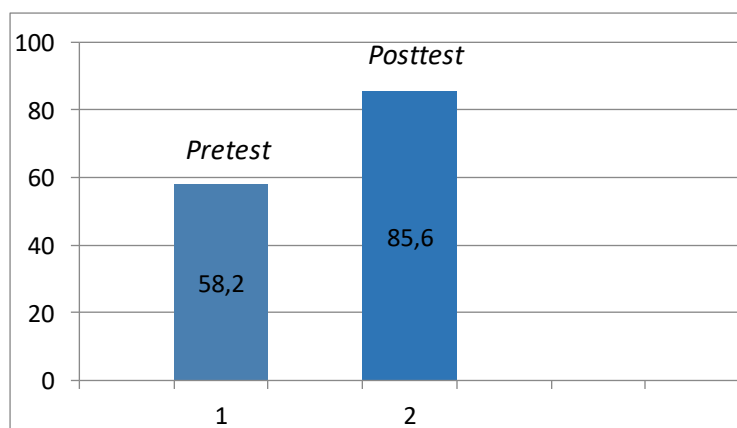


Figure 1. Comparison of Pre-test and Post-test Average Scores

Data Analysis Prerequisite Test

A prerequisite test, a normality test, was conducted to ensure that all research variable data were normally distributed, as a primary requirement for using parametric statistics. This test used the Lilliefors method by observing the largest absolute difference (L_0) in each data group. The data tested included pre-test scores, post-test scores, and the total score from the questionnaire. The decision-making criteria were based on a comparison of the calculated Lilliefors (L_0) and the Lilliefors Table (L_{tabel}) values at a significance level of $\alpha = 0.05$, with a total of 25 students ($N = 25$). If the (L_0) value is less than (L_{tabel}) ($L_0 < 0.173$), the data are considered normally distributed. The summary results of the Lilliefors test are presented in full in Table 1 below.

Table 1. Summary Results of Lilliefors Normality Test (N=25) Excel

Variabel Data	Jumlah Sampel (N)	Lilliefors Hitung (L_0)	Lilliefors Tabel (L_{tabel})	Keterangan
Pretest Score	25	0,172	0,173	Normally Distributed
Posttest Score	25	0,087	0,173	Normally Distributed
Questionnaire Score	25	0,120	0,173	Normally Distributed

Based on Table 1. above, the results of the normality test using the Lilliefors method show that all data groups have a Lilliefors Calculation value (L_0) that is smaller than the Lilliefors Table critical value (L_{tabel}) at a significance level of $\alpha = 0.05$ for a sample size of 25 respondents ($L_{tabel} = 0.180$). In detail, the *pre-test* value data produces a Lilliefors Calculation value (L_0) of 0.172 ($0.172 < 0.180$). For the *post-test* value data, the Lilliefors Calculation value (L_0) is 0.087 ($0.087 < 0.180$). Meanwhile, the questionnaire score data produces a Lilliefors Calculation value (L_0) of 0.120 ($0.120 < 0.180$). Because the Lilliefors Count values of the three types of data meet the testing criteria, namely ($L_0 < L_{tabel}$), the null hypothesis (H_0) is accepted. Thus, it can be concluded that the pre-test, post-test, and questionnaire scores in this study are normally distributed. This normally distributed data condition fulfills the prerequisite requirements for continuing hypothesis testing using parametric statistical analysis.

Correlation Coefficient Analysis of Research Variables

After the data were confirmed to be normally distributed in the previous prerequisite tests, the analysis continued with a Pearson Product Moment correlation test to determine the closeness of the relationship between the research variables. The correlation coefficient test is used to determine whether or not there is an influence between the independent variable (X) and the dependent variable (Y). The requirement for the correlation coefficient test is to see if $r_{\text{calculated}} \geq r_{\text{table}}$ using the product moment correlation formula using SPSS version 25, as shown in Table 2 below:

Table 2. Correlation Results Table below:

Correlations			
		Simple Hologram Media Based on Problem Based Learning Model	Learning outcomes
Simple Hologram Media Based on Problem Based Learning Model	Pearson Correlation	1	.843**
	Sig. (2-tailed)		.000
	N	25	25
Learning outcomes	Pearson Correlation	.843**	1
	Sig. (2-tailed)	.000	
	N	25	25

** . Correlation is significant at the 0.01 level (2-tailed).

Based on the results of calculations carried out using SPSS, the results of the correlation coefficient $r_{xy} = 0.843$ were obtained with the number of respondents (n) = 25 students, so that $r_{table} = 0.367$ was obtained. Based on the results of the Pearson correlation test, a significance value (Sig. 2-tailed) of $0.000 < 0.05$ was obtained and the r_{count} value was $0.843 > r_{table} 0.367$. Thus, the decision of the statistical test is that H_0 is rejected and H_a is accepted. This shows that there is a significant relationship or influence between the application of simple hologram media based on the Problem Based Learning model on student learning outcomes.

Coefficient of Determination test (R^2)

Based on the calculation of the coefficient of determination, a value of 71.06% was obtained. This indicates that the use of simple hologram media based on the Problem Based Learning model contributed 71.06% to the learning outcomes of the fifth grade students of SD Negeri 060971 Kemenangan Tani on the subject of the Solar System. Meanwhile, the remaining 28.94% was influenced by other factors not examined in this study. Thus, the influence of simple hologram media based on the Problem Based Learning model on student learning outcomes is classified as strong.

The Influence of Simple Hologram Media Based on the Problem Based Learning Model on Learning Outcomes

After the data is declared normally distributed and the samples come from the same or homogeneous population, the hypothesis can be tested using a t-test. The t-test is used to determine whether simple hologram media based on the Problem-Based Learning model has a significant effect on learning outcomes. The proposed hypothesis is:

Ha: There is a positive and significant effect between Simple Hologram media on fifth-grade science learning outcomes based on the problem-based learning model for the Solar System, UPT SDN 060971 Kemenangan Tani, in the 2025/2026 academic year.

Ho: There is no positive and significant effect between Simple Hologram media on fifth-grade science learning outcomes based on the problem-based learning model for the Solar System, UPT SDN 060971 Kemenangan Tani, in the 2025/2026 academic year.

Hypothesis testing using the t-test is done by comparing $t_{count} \geq t_{table}$, if $t_{count} \geq t_{table}$ then the hypothesis is accepted if $t_{count} \leq t_{table}$ then the hypothesis is rejected. The following will be tested using the t-test, namely:

$$\begin{aligned}
 t &= \frac{r\sqrt{n-2}}{1-r^2} \\
 t &= \frac{0,843\sqrt{25-2}}{1-(0,843)^2} \\
 t &= \frac{0,843\sqrt{23}}{\sqrt{1-(0,7106)}} \\
 t &= \frac{(0,843) \cdot (4,7958)}{\sqrt{0,2894}} \\
 t &= \frac{4,0428}{0,5379} \\
 t &= 7,511
 \end{aligned}$$

Below we will present a table of the results of hypothesis testing with the help of the SPSS version 25 program.

Table 3. Hypothesis Test (t-Test)

		Coefficients ^a		t	Sig.
Model		Unstandardized Coefficients	Standardized Coefficients		
		B	Std. Error		
1	(Constant)	42.127	5.817	7.242	.000
	Simple Hologram Media Based on Problem Based Learning Model	.609	.081	.843	.000

a. Dependent Variable: Learning outcomes

Based on the table above, it can be seen that the calculation results obtained a t_{count} value of 7.511 and a t_{table} of 2.063 so that $t_{\text{count}} \geq t_{\text{table}}$, then H_a is accepted, namely that simple hologram media based on the problem based learning model (X) has a positive and significant influence on student learning outcomes (Y).

The success of improving learning outcomes is supported by the use of simple holograms, which display concrete and interactive three-dimensional visualizations. Combined with the Problem-Based Learning model, this medium helps students understand abstract concepts, increases learning interest, strengthens memory, and encourages active involvement in problem-solving. Thus, multimedia visual-based learning has proven more effective than conventional methods.

CONCLUSIONS

Based on the research findings and discussion, it can be concluded that the use of simple hologram media integrated with the Problem-Based Learning (PBL) model has a positive and significant effect on the science learning outcomes of fifth-grade students at UPT SDN 060971 Kemenangan Tani. The integration of three-dimensional visual media and problem-based learning creates a more concrete, interactive, and student-centered learning environment. This approach helps students understand abstract scientific concepts, particularly the Solar System, through visual representations and active problem-solving activities. Furthermore, the combination encourages students to participate more actively, develop critical thinking skills, and demonstrate greater interest in learning. These findings indicate that simple hologram media supported by the PBL model can serve as an alternative instructional strategy for improving science learning outcomes in elementary schools. Therefore, teachers are encouraged to consider integrating innovative visual media with student-centered learning models to create more meaningful learning experiences and support students' conceptual understanding.

REFERENCES

- Abdulrahman, M. D., Faruk, N., Oloyede, A. A., Surajudeen-Bakinde, N. T., Olawoyin, L. A., Mejabi, O. V., Imam-Fulani, Y. O., Fahm, A. O., & Azeez, A. L. (2020). Multimedia tools in the teaching and learning processes: A systematic review. *Heliyon*, 6(11), e05312. <https://doi.org/10.1016/j.heliyon.2020.e05312>
- Ainullah, A. N., Jampel, I. N., & Sudatha, I. G. W. (2023). Interactive learning multimedia with problem-based learning for fifth-grade elementary school students. *Jurnal Ilmiah Sekolah Dasar*, 7(2), 316–326. <https://doi.org/10.23887/jisd.v7i2.57377>
- Armadhani, D., J, F. Y., Zen, Z., & Rayendra. (2025). Development of interactive multimedia for sciences based on problem-based learning in grade v of elementary school. *Jurnal Penelitian Pendidikan IPA*, 11(7), 570–578. <https://doi.org/10.29303/jppipa.v11i7.11420>
- Council, N. R. (2012). *A framework for k-12 science education: Practices, crosscutting concepts, and*

- Hoon, L. N., & Shaharuddin, S. S. (2019). Learning effectiveness of 3d hologram animation on primary school learners. *Journal of Visual Art and Design*, 11(2), 93–104. <https://doi.org/10.5614/j.vad.2019.11.2.2>
- Khoirunnisa, K., & Solihin, M. M. (2026). Interactive digital media in problem-based science learning in elementary schools: A systematic literature review. *International Journal of Elementary School*, 3(2), 54–68. <https://doi.org/10.69637/ijes.v3i2.866>
- Kristiana, T. F., & Radia, E. H. (2021). Meta analisis penerapan model problem based learning dalam meningkatkan hasil belajar IPA siswa sekolah dasar. *Jurnal Basicedu*, 5(2), 818–826. <https://doi.org/10.31004/basicedu.v5i2.828>
- Mayer, R. E. (2008). Applying the science of learning: Evidence-based principles for the design of multimedia instruction. *American Psychologist*, 63(8), 760–769. <https://doi.org/10.1037/0003-066X.63.8.760>
- Ningsih, I. A. A., Susilowati, D., & Madani, M. (2025). Pengembangan multimedia pembelajaran interaktif berbasis desktop untuk mata pelajaran IPA sekolah dasar. *UPGRADE: Jurnal Pendidikan Teknologi Informasi*, 3(1), 11–21. <https://doi.org/10.30812/284wgt46>
- Noviana, D., Tellu, A. T., & Rede, A. (2022). The application of problem based learning models assisted by instructional videos to improve student science learning outcomes for elementary school. *Jurnal Universitas Tadulako*, 6(1), 11–20. <https://doi.org/10.22487/j25490192.2022.v6.i1.pp11-20>
- Nugroho, C. D. A., & Nugraha, R. B. (2024). Meta analisis: Pengaruh model pembelajaran problem based learning terhadap hasil belajar IPA SD. *Didaktik: Jurnal Ilmiah PGSD STKIP Subang*, 10(1), 1407–1415. <https://doi.org/10.36989/didaktik.v10i1.2645>
- Nurrafiah, E. Y., Putra, M. J. A., & Zufriady, Z. (2023). The relationship between the use of pyramid hologram media and student activities in science learning in elementary schools. *al-ishlah: Jurnal pendidikan*, 15(4). <https://doi.org/10.35445/alishlah.v15i4.3148>
- Yu, Q., Li, B., & Wang, Q. (2024). The effectiveness of 3D holographic technology on students' learning performance: A meta-analysis. *Interactive Learning Environments*, 32(5), 1629–1641. <https://doi.org/10.1080/10494820.2022.2124424>
- Yanto, F., Sulistianingsih, M., Erfani, D., Nisa, K., Aini, N., & Dito. (2026). Effectiveness of problem-based learning on science problem-solving skills: A meta-analysis. *Journal of Turkish Science Education*, 23(1), 91–108. <https://doi.org/10.36681/tused.2026.005>
- Zakirman, Z., Rahayu, C., & Gusta, W. (2022). E-animation media to improve the understanding of elementary school science learning. *Jurnal Basicedu*, 6(3). <https://doi.org/10.31004/basicedu.v6i3.2595>