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Effect of the Think Talk Write Cooperative Learning Model Assisted by Poster Media on Students' Learning Outcomes in Biology Among Grade VIII Students at SMP Negeri 19 Palu

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Abstract: This study aimed to examine the effect of a poster-assisted Think Talk Write cooperative learning model on eighth-grade students' learning outcomes in biology at SMP Negeri 19 Palu. A quasi-experimental method was employed using a nonequivalent control group design. The study involved two classes selected through purposive sampling: Class VIII A, consisting of 31 students, served as the control group, while Class VIII C, consisting of 28 students, served as the experimental group. Data were collected using a multiple-choice achievement test. The findings showed that the poster-assisted Think Talk Write cooperative learning model had a significant effect on students' learning outcomes in the topic of the excretory system. The Mann–Whitney U test comparing the posttest scores of the experimental and control groups yielded an Asymp. Sig. (two-tailed) value of 0.001, which was lower than the significance level of 0.05. This result indicated a statistically significant difference between the two groups after the intervention. Furthermore, the experimental group achieved a mean normalized gain of 73% (g = 0.73), which was higher than that of the control group, which achieved 55% (g = 0.55). These findings demonstrate that the poster-assisted Think Talk Write learning model significantly improves students' biology learning outcomes. Therefore, this model may be considered an effective alternative instructional strategy for enhancing student achievement.

Keywords: Think Talk Write; posters; learning outcomes; biology education

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INTRODUCTION

Learning is an interactive process through which teachers and students exchange information within a structured educational environment. Successful learning requires the active participation of both parties in achieving predetermined instructional objectives and satisfactory learning outcomes (Kahar et al., 2020). Learning outcomes are therefore an important indicator of the effectiveness of the instructional process and should be evaluated to determine whether the intended educational objectives have been achieved (Purwanto, 2014). In this study, learning outcomes refer specifically to students' cognitive achievement in biology, as measured through their mastery of the instructional content.

SMP Negeri 19 Palu is a public junior high school located in Tondo Subdistrict, Mantikulore District, Central Sulawesi Province. Preliminary information obtained through an interview with the Grade VIII biology teacher indicated that students' biology achievement during the second semester of the 2024/2025 academic year remained below the expected standard. The students obtained an average score of 74.09, which was lower than the school's Minimum Mastery Criterion (*Kriteria Ketuntasan Minimal*,

KKM) of 75. In addition, 54.62% of the students did not achieve the KKM, suggesting that more than half had not adequately mastered the biology content.

Classroom instruction was predominantly conducted through teacher-centered lectures. Consequently, students tended to be passive, participated minimally in group discussions, and experienced difficulty expressing and organizing their ideas systematically. The limited use of varied instructional media also contributed to this problem. Biology instruction relied primarily on textbooks and PowerPoint presentations, with little use of engaging visual media that could encourage students to observe, discuss, and interpret biological concepts. These conditions reduced students' classroom engagement, concentration, and enthusiasm for learning, which may have contributed to their low achievement. Accordingly, an instructional strategy that combines active student participation with appropriate visual support is needed to improve the quality of biology learning.

One instructional approach that may address these problems is the Think Talk Write (TTW) cooperative learning model. TTW structures learning through three interrelated stages: individual thinking (*think*), collaborative discussion (*talk*), and written expression (*write*). During the *think* stage, students independently examine information and formulate initial ideas. In the *talk* stage, they exchange, clarify, and evaluate their ideas through group discussion. In the *write* stage, they reorganize and express their understanding in written form. These stages promote active cognitive processing because students are required not only to receive information but also to interpret, communicate, and reconstruct it.

Previous studies have reported positive effects of TTW-based instruction. Riski et al. (2017) found that the TTW model improved students' learning activities and outcomes by positioning students as active participants rather than passive recipients of information. Rifaid and Sakban (2017) similarly reported that TTW was more effective than conventional instruction and could serve as an alternative strategy for improving learning outcomes. In biology education, Listiana et al. (2016) demonstrated that TTW and its integration with group investigation enhanced students' metacognitive skills more effectively than conventional teaching. This evidence suggests that the thinking, discussion, and writing processes embedded in TTW can support students' regulation and development of biological understanding.

In addition to an appropriate learning model, instructional media play an important role in increasing students' attention, motivation, and understanding. Instructional media serve not only as teaching aids but also as components of the learning environment that can influence students' engagement with the material (Surata, 2020). Posters are visual media that combine images, text, graphics, and colors to communicate key information in a concise and attractive format (Nurdiana, 2021). Niska (2013) further explained that posters generally emphasize one or two central ideas to attract attention, facilitate comprehension and retention, and encourage particular responses.

The potential educational value of posters is supported by research on visual and multimedia learning. Visual representations allow learners to examine complex or otherwise unobservable scientific phenomena and contribute to conceptual understanding and knowledge construction (Evagorou et al., 2015). Rau (2017) also reported that combining text with visual representations can improve students' content learning compared with text-only instruction, provided that the representations are clear and relevant. According to the cognitive theory of multimedia learning, students learn meaningfully when they select relevant verbal and visual information, organize it into coherent mental representations, and integrate it with their prior knowledge

(Mayer, 2024). Thus, a well-designed poster may support learning by presenting verbal and visual information in a complementary and cognitively manageable form.

Visual media are particularly relevant to biology because many biological processes involve structures and relationships that are difficult to observe directly. The excretory system, for example, includes the structures, locations, and functions of several organs as well as the relationships among these components. Students may therefore experience difficulty understanding how the structures of excretory organs are related to their physiological functions (Shinta et al., 2025). Poster media can help students visualize these concepts through concise explanations and organized illustrations (Utami et al., 2024). Evidence from secondary biology education also indicates that systematically designed multimedia instruction can simplify abstract content, promote a more active learning environment, and improve students' academic achievement (Kassa et al., 2024).

Although previous studies have demonstrated the benefits of TTW and visual instructional media, these approaches have generally been examined separately. Studies of TTW have primarily focused on its effects on learning activities, metacognition, or achievement, whereas studies of poster media have largely examined their role in attracting attention and facilitating conceptual understanding. Consequently, empirical evidence regarding the combined implementation of TTW and poster media remains limited, particularly in junior high school biology instruction on the excretory system. Existing studies have not sufficiently explained whether posters can provide a shared visual basis for the thinking, discussion, and writing activities required in the TTW model. This limitation constitutes an important research gap because the effectiveness of instructional media depends not only on their visual qualities but also on how students cognitively and socially engage with the information they present.

The integration of poster media with TTW is theoretically expected to produce complementary effects. Posters provide organized visual and verbal information that students can examine during the *think* stage. During the *talk* stage, the same visual information can serve as a common reference for comparing ideas, correcting misunderstandings, and constructing explanations collaboratively. In the *write* stage, students can reorganize the results of their observations and discussions into coherent written explanations. Writing may also enable teachers to assess the extent to which students have developed an accurate understanding of the concepts. Through this sequence, the poster does not function merely as a display medium but as a cognitive and communicative resource throughout the learning process.

The novelty of the present study therefore lies in examining the integrated implementation of the poster-assisted TTW cooperative learning model in teaching the human excretory system to Grade VIII students. Unlike approaches that employ TTW or posters independently, the proposed intervention positions the poster as an integral resource within each TTW stage. This integration is expected to provide a more active, collaborative, and visually supported learning experience. As suggested by Safitri (2022), students can develop meaningful understanding not only through teachers' explanations but also through thinking, discussion, writing, and direct engagement with visual representations. Purwanto (2023) also stated that poster-assisted TTW instruction may increase students' interest and motivation to learn.

Based on the identified classroom problems, theoretical considerations, and research gap, this study aimed to determine the effect of the poster-assisted Think Talk Write cooperative learning model on the cognitive biology learning outcomes of Grade VIII students at SMP Negeri 19 Palu.

METHOD

Research Design

This study employed a quantitative research approach using a quasi-experimental method with a nonequivalent control group design. The design involved two groups, each of which completed a pretest and a posttest. The experimental group received instruction using the poster-assisted Think Talk Write (TTW) learning model, whereas the control group received instruction without the poster-assisted TTW model. The nonequivalent control group design used in this study is presented in Table 1.

Table 1. Nonequivalent control group design

Pretest	Treatment	Posttest
$\mathbf{O_1}$	X	O_2
$\mathbf{O_3}$	–	O_4

Population and Sample

The study sample consisted of two eighth-grade classes. Class VIII A, comprising 31 students, served as the control group, whereas Class VIII C, comprising 28 students, served as the experimental group. The control group did not receive the experimental treatment, whereas the experimental group received the designated intervention (Muhajir et al., 2019). Specifically, the control group was taught using the lecture method, while the experimental group was taught using the poster-assisted Think Talk Write cooperative learning model.

The sample was selected using purposive sampling, a technique in which participants are selected based on specific considerations. In this study, sample selection was based on criteria predetermined by the researchers, including having the same subject teacher, receiving the same instructional content, and following the same learning schedule.

Data Collection Technique and Research Instrument

Data were collected using a test. Testing is an evaluation technique used to collect research data and measure the extent of students' development or progress (Apriani et al., 2025).

A research instrument is a tool used to collect data in a study (Purwanto, 2018). The instrument used in this study was a 20-item multiple-choice achievement test designed to assess students' cognitive abilities regarding the human excretory system. These abilities were measured indirectly through stimuli presented to the respondents (Suseno & Saputra, 2025). Each correct answer was assigned a score of 5, whereas each incorrect answer received a score of 0. Thus, the maximum possible score was 100.

The instrument was developed by the researchers based on competency achievement indicators and a test blueprint aligned with the learning objectives. The questions were constructed to assess cognitive abilities at the levels of remembering, understanding, applying, and analyzing (C1–C4). The test blueprint ensured alignment among the basic competencies, learning indicators, and cognitive levels being assessed, thereby supporting the validity of the instrument.

Instrument validity was evaluated through expert judgment involving three lecturers, who assessed the appropriateness of the content, item construction, and language. The validators awarded a total score of 142 out of a maximum possible score of 150, corresponding to an instrument validity percentage of 95%. Based on the established validity criteria, the instrument was categorized as highly valid and suitable for use in the study.

Learning Media

The instructional medium used in this study was a poster on the human excretory system. The poster was developed by the researchers and used as the primary learning medium during the experimental intervention. Its content was developed according to the learning indicators, including the excretory organs—the kidneys, liver, lungs, and skin—the functions of these organs, methods of maintaining their health, and the processes involved in eliminating metabolic waste. The poster incorporated visual illustrations and concise textual explanations arranged systematically to ensure alignment with the learning objectives.

Research Procedure

The study followed a quasi-experimental procedure using a nonequivalent control group design. The initial stage involved preparing the instructional materials, including lesson plans, student worksheets, and posters, as well as developing the test instrument.

During the implementation stage, the experimental group received instruction using the poster-assisted Think Talk Write learning model. The intervention was conducted over two meetings, each lasting 2 × 40 minutes.

During the Think stage, students observed the poster illustrating the human excretory system and identified important information concerning the excretory organs, their functions, methods of maintaining organ health, and the excretion process. During the Talk stage, students discussed their observations in groups and answered the questions provided in the student worksheets. During the Write stage, students documented the results of their discussions as written responses based on the material they had studied.

In contrast, the control group received instruction through the lecture method, supplemented by question-and-answer activities and student assignments. Both groups completed a pretest and a posttest to obtain data on students' learning outcomes. The final stage involved collecting, processing, and analyzing the data to draw conclusions from the study.

Data Analysis

Data analysis comprised prerequisite tests, hypothesis testing, and an N-gain analysis. The prerequisite tests included tests of normality and homogeneity. Normality and homogeneity testing are essential stages of data analysis because they determine whether the statistical assumptions required for further analysis have been satisfied (Agustian et al., 2025).

The normality test was conducted to determine whether the data from both sample groups followed a normal distribution and, consequently, to identify the appropriate statistical procedure for hypothesis testing (Nurhaswindah et al., 2026). The homogeneity test was subsequently conducted to determine whether the variances of the sample groups were equivalent (Sianturi, 2022).

Hypothesis testing was performed to determine whether the research hypothesis formulated during the initial research design stage was supported, as stated by Anuraga et al. (2021) in Toedien et al. (2025). All statistical analyses were conducted using SPSS. The hypotheses were formulated as follows:

H_0: The poster-assisted TTW (Think–Talk–Write) cooperative learning model has no significant effect on students' learning outcomes in Biology among eighth-grade students at SMP Negeri 19 Palu.

H_1: The poster-assisted TTW (Think–Talk–Write) cooperative learning model has a significant effect on students' learning outcomes in Biology among eighth-grade students at SMP Negeri 19 Palu.

The decision-making criterion for hypothesis testing was based on the significance value. When the significance value was greater than 0.05, H_0 was accepted; when the significance value was less than or equal to 0.05, H_0 was rejected and H_1 was accepted (Hasanah et al., 2021).

An N-gain, or normalized gain, analysis was subsequently conducted to determine the improvement in students' cognitive learning outcomes (Nurbaity et al., 2023). The N-gain was calculated using the following equation:

$$\text{N-gain} = \frac{\text{posttest score} - \text{pretest score}}{\text{maximum ideal score} - \text{pretest score}}$$

The effectiveness criteria based on the N-gain values, according to Sari and Apriani (2014) in Wati et al. (2021), are presented in Table 2.

Table 2. Criteria for improvement in learning outcomes

N-gain score	Criterion
$g < 0{,}3$	Low
$0{,}3 \leq g \leq 0{,}7$	Moderate
$g > 0{,}7$	High

Source: Sari & Apriani (2014)

RESULTS AND DISCUSSION

Data obtained from the experimental and control classes were analyzed to generate descriptive statistics. All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS). The descriptive statistics for students' learning outcomes are presented in Table 3.

Table 3. Descriptive analysis of students' learning outcomes

Learning Outcome	Class	N	Minimum	Maximum	Mean
Pre-test	Control	31	25	65	46.77
	Experimental	28	35	65	55.00
Post-test	Control	31	50	90	75.97
	Experimental	28	70	100	87.68

As shown in Table 3, the mean pre-test score was 46.77 in the control class and 55.00 in the experimental class. Following the intervention, the mean post-test score increased to 75.97 in the control class and 87.68 in the experimental class. These descriptive findings indicate that the experimental class achieved a greater improvement in learning outcomes than the control class.

Students' learning-outcome data were subsequently analyzed using normality, homogeneity, hypothesis, and normalized gain (N-gain) tests. The first analysis was the normality test, which was conducted to determine whether the data followed a normal distribution. Normality was assessed using the Kolmogorov–Smirnov test in SPSS. Data were considered normally distributed when the significance value was greater than 0.05 and non-normally distributed when the significance value was less than 0.05. The normality test was applied to both the pre-test and post-test data, as presented in Table 4.

Table 4. Results of the normality test

Learning Outcome	Class	Mean	df	Sig.	Interpretation
Pre-test	Control	46.77	31	0.021	Non-normal
	Experimental	55.00	28	0.002	Non-normal
Post-test	Control	75.97	31	0.001	Non-normal
	Experimental	87.68	28	0.126	Normal

Based on the Kolmogorov–Smirnov test results presented in Table 4, the significance values for the experimental class were 0.002 for the pre-test and 0.126 for the post-test. Because the pre-test significance value was below 0.05, the experimental-class pre-test data were not normally distributed. In contrast, the post-test significance value exceeded 0.05, indicating that the experimental-class post-test data were normally distributed.

For the control class, the significance values were 0.021 for the pre-test and 0.001 for the post-test. Both values were below 0.05, indicating that neither the pre-test nor the post-test data in the control class were normally distributed.

The next analysis was the homogeneity test, which was conducted to determine whether the experimental and control groups had equal variances. Homogeneity was assessed using Levene's test. A significance value greater than 0.05 indicated homogeneous variances, whereas a significance value below 0.05 indicated heterogeneous variances. The results for the pre-test and post-test data are presented in Table 5.

Table 5. Results of the homogeneity test

Learning Outcome	Levene Statistic	df1	df2	Sig.	Interpretation
Pre-test	0.155	1	57	0.736	Homogeneous
Post-test	0.897	1	57	0.348	Homogeneous

As shown in Table 5, the significance value for the pre-test data was 0.736, which was greater than 0.05. Therefore, the pre-test variances were homogeneous. Similarly, the significance value for the post-test data was 0.348, which was also greater than 0.05, indicating homogeneous post-test variances. These findings suggest that the experimental and control classes were drawn from populations with equal variances.

Hypothesis testing was then conducted to determine whether the research hypothesis formulated at the beginning of the study was supported. Because the data were not normally distributed, the Mann–Whitney U test was used as a nonparametric alternative to the independent-samples *t*-test (Sianturi, 2025). The Mann–Whitney U test was used to determine whether students' learning outcomes differed significantly between the control and experimental groups.

The hypothesis-testing criteria were as follows: when the two-tailed significance value was greater than 0.05, H0 was accepted and H1 was rejected; when the two-tailed significance value was below 0.05, H0 was rejected and H1 was accepted. The results are presented in Table 6.

Table 6. Results of the Mann–Whitney U test

Learning Outcome Comparison	Sig.	Interpretation
Control and experimental pre-tests	0.001	Significant
Control and experimental post-tests	0.001	Significant

The Mann–Whitney U test produced an asymptotic two-tailed significance value of 0.001, which was below 0.05. Based on the decision criteria, H0 was rejected and H1 was accepted. Therefore, the poster-assisted Think Talk Write cooperative learning model had a statistically significant effect on the biology learning outcomes of Grade VIII students at SMP Negeri 19 Palu.

The final analysis involved the N-gain test, which was conducted to determine the magnitude of improvement in students' learning outcomes from the pre-test to the post-test following the instructional intervention. The N-gain analysis was performed for both the control and experimental classes. The results are presented in Table 7.

Table 7. Comparison of pre-test scores, post-test scores, score improvements, and N-gain values in the control and experimental classes

Class	N	Pre-test	Post-test	Improvement	N-gain	Category
Control	31	46.77	75.97	29.20	0.55	Moderate
Experimental	28	55.00	87.68	32.68	0.73	High

As shown in Table 7, the mean score in the control class increased from 46.77 on the pre-test to 75.97 on the post-test, representing an increase of 29.20 points. The resulting N-gain value was 0.55, which was categorized as moderate. In the experimental class, the mean score increased from 55.00 on the pre-test to 87.68 on the post-test, representing an increase of 32.68 points. The N-gain value was 0.73, which was categorized as high. These results indicate that the improvement in students' learning outcomes was greater in the experimental class than in the control class.

The findings indicate that the poster-assisted Think Talk Write (TTW) cooperative learning model has the potential to support students' biology learning outcomes. Although both classes improved after instruction, the experimental class showed a greater descriptive increase and a higher N-gain category than the control class. This pattern suggests that the learning activities implemented in the experimental class may have provided stronger support for students' conceptual development.

These findings are consistent with Ryanti (2016), who reported that TTW instruction improved students' learning outcomes across successive learning cycles and supported development in the cognitive, affective, and psychomotor domains. Similar results were reported by Nasution et al. (2015), who found that the use of TTW supported by visual media in teaching Protista produced better learning outcomes than lecture-based biology instruction.

The greater improvement observed in the experimental class may be explained by the instructional structure of the TTW model. During the thinking stage, students independently process the learning material and identify key concepts. During the talking stage, they exchange ideas, compare interpretations, and clarify their understanding through peer discussion. The writing stage then requires students to organize and express their knowledge systematically. Together, these stages encourage students to engage actively with the learning material rather than merely receive information from the teacher.

Poster media may further strengthen this process by presenting biological concepts in a concise and visually accessible format. Because biology frequently involves structures, classifications, processes, and conceptual relationships, visual representations may help students identify essential information and connect related ideas. The combination of thinking, discussion, writing, and visual representation may

therefore promote more meaningful information processing and facilitate conceptual retention.

The present findings are also supported by Juanda & Istianah (2023), who reported that a poster-assisted TTW cooperative learning model produced a higher N-gain in the experimental class than in the control class. Safitri et al. (2022, as cited in Juanda & Istianah, 2023) similarly argued that TTW instruction can improve science learning outcomes by increasing students' active participation in the learning process.

Compared with previous studies, the present study demonstrates a similar pattern of improved learning outcomes following the implementation of TTW-based instruction. However, differences in the magnitude of improvement across studies may be associated with variations in student characteristics, instructional content, classroom conditions, implementation fidelity, duration of treatment, and the design of the poster media used.

The lower improvement observed in the control class may be related to the characteristics of lecture-based instruction. When learning is dominated by one-way communication, students may have fewer opportunities to express their reasoning, discuss alternative explanations, and organize their understanding independently. Consequently, students may become more passive during the learning process.

This interpretation is consistent with Susanti et al. (2024), who stated that excessive reliance on one-way lecture-based instruction may contribute to boredom, reduced motivation, and limited cognitive engagement because students receive insufficient interaction and stimulation. Similarly, Mutia et al. (2025) reported that teacher-dominated instruction may lead to passivity, lower motivation, and weaker understanding of the learning material.

Nevertheless, the improvement achieved by the control class indicates that conventional instruction still contributed to students' learning through teacher explanations, classroom discussions, and exercises. The difference between the two classes should therefore not be interpreted as evidence that lecture-based instruction was ineffective, but rather that the poster-assisted TTW model may have provided additional opportunities for students to process and communicate their understanding.

The findings should also be interpreted cautiously because the experimental and control classes differed significantly in their initial achievement. The higher post-test performance of the experimental class cannot therefore be attributed solely to the instructional intervention. The results are better understood as evidence of a potential instructional benefit rather than definitive proof of a causal effect.

In addition, this study did not directly measure students' motivation, participation, responsibility, or classroom engagement. Explanations involving these factors should therefore be regarded as plausible mechanisms rather than directly observed outcomes. The study was also conducted with a limited sample in one school using purposive sampling, which restricts the generalizability of the findings.

Future studies should involve larger and more diverse samples, use groups with more comparable baseline abilities, and apply statistical procedures that control for pre-test differences. Further research should also examine affective and behavioral variables to provide a more comprehensive explanation of how poster-assisted TTW instruction influences students' learning.

CONCLUSION

Based on the findings and analyses of this study, the implementation of the Think Talk Write (TTW) cooperative learning model supported by poster media had a significant effect on the Biology learning outcomes of Grade VIII students at SMP

Negeri 19 Palu. The Mann–Whitney U test comparing the posttest scores of the experimental and control groups yielded an Asymp. Sig. (2-tailed) value of 0.001, which was lower than the significance level of 0.05. This result indicates a statistically significant difference between the experimental and control groups after the intervention.

In addition, the experimental group achieved a mean N-gain of 73% (g = 0.73), which was higher than the mean N-gain of 55% (g = 0.55) obtained by the control group. These findings demonstrate that the TTW learning model supported by poster media significantly improved students' learning outcomes. Therefore, this model may be considered an alternative instructional strategy for enhancing students' achievement in Biology.

RECOMMENDATION

Based on the findings of this study, several recommendations are proposed. First, teachers may use the Think Talk Write (TTW) learning model supported by poster media as an alternative instructional strategy to improve students' learning outcomes, particularly in Biology. Teachers should manage each stage of the TTW model effectively to promote students' active participation throughout the learning process.

Second, students are encouraged to participate actively in all learning activities, particularly during the thinking, discussion, and writing stages, to develop a more comprehensive understanding of the learning material.

Third, future researchers are encouraged to conduct similar studies using different types of instructional media or by integrating the TTW model with other learning approaches. Further research may also be conducted using different subject matter or at different educational levels to generate broader and more comprehensive findings.

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REFERENCES

Agustian, A., Lisdiana, K., Suryana, A., & Nursalman, M. (2025). Analisis statistik uji normalitas dan homogenitas data nilai mata pelajaran dengan menggunakan Python. *Jurnal Keislaman, Kemasyarakatan, dan Pendidikan, 10*(1), 51–56.

Anggraeny, D., Mahmudah, S., & Widajati, W. (2024). Penerapan model *cooperative learning* bermedia video untuk meningkatkan hasil belajar siswa tunagrahita ringan dalam pembelajaran IPA di sekolah menengah pertama luar biasa. *13*(1), 1133–1140.

Apriani, W., Indra, S., Mardiah, A., & Adriantoni. (2025). Evaluasi dalam kegiatan pembelajaran: Klasifikasi model dan tekniknya. *Jurnal Ilmiah PGSD STKIP Subang, 10*(2), 250–257.

Evagorou, M., Erduran, S., & Mäntylä, T. (2015). The role of visual representations in scientific practices: From conceptual understanding and knowledge generation to “seeing” how science works. *International Journal of STEM Education, 2*, Article 11. https://doi.org/10.1186/s40594-015-0024-x

Hasanah, U., Sarjono, & Hariyadi, A. (2021). Pengaruh model *problem-based learning* terhadap prestasi belajar IPS SMP Taruna Kedung Adem. *Aksara: Jurnal Ilmu Pendidikan Nonformal, 7*(1), 43–52.

Huda, M. (2013). *Model-model pengajaran dan pembelajaran: Isu-isu metodis dan paradigmatis*.

Juanda, P. S. D., & Istianah, F. (2023). Pengaruh model pembelajaran kooperatif *Think Talk Write* berbantuan poster terhadap hasil belajar IPA materi transformasi energi kelas IV UPT SD Negeri 242 Gresik. *JPGSD, 11*(6), 1362–1371.

Kahar, M. S., Anwar, Z., & Murpri, D. K. (2020). Pengaruh model pembelajaran kooperatif tipe *jigsaw* terhadap peningkatan hasil belajar. *Aksioma: Jurnal Program Studi Pendidikan Matematika, 9*(2), 279–295.

Kassa, M. M., Azene, M. K., Mengstie, S. M., & Ferede, M. W. (2024). Effect of using multimedia and dynamic classroom integrated instruction on Grade 11 students’ biology academic achievement. *Heliyon, 10*, e37315. https://doi.org/10.1016/j.heliyon.2024.e37315

Listiana, L., Susilo, H., Suwono, H., & Suarsini, E. (2016). Empowering students’ metacognitive skills through new teaching strategy (group investigation integrated with Think Talk Write) in biology classroom. *Journal of Baltic Science Education, 15*(3), 391–400.

Mayer, R. E. (2024). The past, present, and future of the cognitive theory of multimedia learning. *Educational Psychology Review, 36*, Article 8. https://doi.org/10.1007/s10648-023-09842-1

Muhajir, Musfikar, R., & Hazrullah. (2019). Efektivitas penggunaan *e-learning* berbasis. *Jurnal Pendidikan Teknologi Informasi, 3*(1), 50–56.

Mutia, N., Najmilah, T., Sismia, Z., Ramadhani, K. R., & Suryapuspita, A. (2025). Perbandingan motivasi belajar siswa melalui metode ceramah dan digital. *Jurnal Pendidikan dan Pembelajaran, 4*(2), 2514–2540.

Niska, B. (2013). Penggunaan media poster untuk peningkatan hasil belajar siswa pada pelajaran pendidikan kewarganegaraan di sekolah dasar. *JPGSD, 1*(2), 0–216.

Nurbaity, B. A., Pramadi, R. A., & Paujiah, E. (2023). Penggunaan media permainan kartu Uno dalam meningkatkan. *Jurnal Edukasi, 1*(1), 139–145.

Nurdiana. (2021). Penerapan media poster materi mematuhi peraturan perundang-undangan untuk meningkatkan motivasi belajar peserta didik kelas VIII H di SMPN 15 Kota Serang. *Untirta Civic Education Journal, 6*(2), 188–199.

Nurhaswindah, Muslimah, N., Yuliani, C. E., Putri, R. A., Mayura, V., Rahmadhansyah, A., Selvira, D., Nurrahman, H., Qadri, R., Bramantyo, D., & Rifaldi, A. (2026). Uji normalitas dan homogenitas dalam analisis statistik. *Didaktik: Jurnal Ilmiah PGSD FKIP Universitas Mandiri, 12*(1), 98–105.

Purwanto. (2014). *Evaluasi hasil belajar*. Pustaka Pelajar.

Purwanto. (2018). *Teknik penyusunan instrumen uji validitas dan reliabilitas penelitian ekonomi syariah* (1st ed.). Staial Press.

Purwanto, A. (2023). Upaya meningkatkan hasil belajar siswa melalui penerapan strategi *Think Talk Write* (TTW) pada pembelajaran akidah akhlak di SMP IT Bina Insan. *Analysis: Journal of Education, 1*(1), 50–59.

Rau, M. A. (2017). Conditions for the effectiveness of multiple visual representations

in enhancing STEM learning. *Educational Psychology Review, 29*, 717–761. https://doi.org/10.1007/s10648-016-9365-3

Rifaid, M., & Sakban, A. (2017). Pengaruh model pembelajaran *Think Talk Write* terhadap hasil belajar siswa pada mata pelajaran PPKn siswa kelas VIII SMPN 11 Mataram. *Civicus: Pendidikan-Penelitian-Pengabdian Pendidikan Pancasila dan Kewarganegaraan, 5*(2), 30–39.

Riski, R., Rizal, M., & Linawati. (2017). Penerapan model pembelajaran kooperatif tipe *Think Talk Write* (TTW) untuk meningkatkan hasil belajar siswa pada materi hubungan sudut pusat, panjang busur, dan luas juring di kelas VIII C SMP Negeri 9 Palu. *Jurnal Elektronik Pendidikan Matematika Tadulako, 5*(2), 175–190.

Safitri, J., Sulistri, & Marhayani, D. A. (2022). Pengaruh model pembelajaran *Think Talk Write* (TTW) berbantuan media poster terhadap hasil belajar ranah kognitif IPA siswa kelas V pada materi makanan sehat di SD Negeri 09 Danau Peradah. *Jurnal Jendela Pendidikan, 2*(4), 504–509.

Shinta, D., Adelia, P., Apriliya, L., Rahmani, S., Virginia, Z., Aryanto, G. B., Ristanto, R. H., & Safitri, D. (2025). Pendekatan guru biologi dengan penerapan model *discovery learning* dalam menyampaikan materi sistem ekskresi terhadap SMA di wilayah urban. *Edusaintek: Jurnal Pendidikan, Sains dan Teknologi, 12*(2), 933–950.

Sianturi, R. (2022). Uji homogenitas sebagai syarat pengujian analisis. *Jurnal Pendidikan, Sains, Sosial, dan Agama, 8*(1), 386–397. https://doi.org/10.53565/pssa.v8i1.507

Sianturi, R. (2025). Test normality as a condition of hypothesis testing. *Jurnal Pembelajaran dan Matematika Sigma (JPMS), 11*(1), 1–14.

Surata, I. K. (2020). Meta-analisis media pembelajaran pada pembelajaran biologi. *Journal of Education Technology, 4*(1), 22–27.

Susanti, S., Aminah, F., Assa'idah, I. M., Aulia, M. W., & Angelika, T. (2024). Dampak negatif metode pengajaran monoton terhadap motivasi belajar siswa. *Pedagogik: Jurnal Pendidikan dan Riset, 2*(2), 86–93.

Suseno, & Saputra, D. (2025). Teknik penyusunan tes hasil belajar. *Journal of Social Science Research, 5*(3), 7502–7512.

Toedien, F. A., Risnawati, & Hamdani, M. F. (2025). Membedah uji prasyarat: Kunci pemilihan uji hipotesis dalam statistik kuantitatif dan panduan cepat SPSS uji prasyarat statistik. *Kaisa: Jurnal Pendidikan dan Pembelajaran, 5*(1), 46–59.

Utami, N. L., Lestari, N. D., & Aradea, R. (2024). Efektivitas penerapan media poster dalam pembelajaran di sekolah: Studi literatur. *5*(1), 310–323.

Wati, D. S., Siahaan, S. M., & Wiyono, K. (2021). Efektivitas *Learning Management System* Chamilo materi gerak harmonik sederhana terhadap hasil belajar peserta didik. *Jurnal Pendidikan IPA, 11*(2), 100–109. https://doi.org/10.24929/lensa.v11i2.166