

## **Enhancing Cognitive Learning Outcomes and Retention through Reflective Learning Journals: Evidence from Senior High School Students**

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**Abstract:** Reflective learning journals are an active learning strategy designed to enhance metacognition and knowledge consolidation. This quasi-experimental study investigated the effect of reflective learning journals on cognitive learning outcomes and knowledge retention among 64 Grade XI science students in Indonesia. A pretest-posttest-retest control group design was employed. The experimental group (n=32) used structured learning journals with teacher feedback, while the control group (n=32) received conventional instruction. Cognitive learning outcomes and retention were measured using validated multiple-choice tests. Results indicated that the experimental group significantly outperformed the control group on both the posttest (M=75.63 vs. M=59.84) and the retention test (M=76.25 vs. M=60.94). MANOVA confirmed a significant multivariate effect of the intervention ( $p < .001$ ). The findings suggest that integrating reflective learning journals with feedback is an effective pedagogical strategy for enhancing both immediate learning and long-term retention in high school biology.”

**Keywords:** Cognitive Learning Outcomes, Knowledge Retention, Reflective Learning Journal

### **A. Introduction**

High-quality education demands instructional processes that engage learners as active constructors of knowledge rather than passive recipients of information (Prasela et al., 2020). Yet, classroom practices in many schools continue to be dominated by teacher-centred approaches, where instruction primarily consists of one-way lecturing and rote transmission of facts. Such conventional methods often restrict students' cognitive engagement, reduce opportunities for conceptual construction, and consequently hinder long-term retention of learned information. Studies comparing passive and active instructional methods consistently indicate that active learning enhances student engagement and deep information processing

factors strongly associated with improved retention whereas passive methods tend to produce less optimal learning gains (Freeman et al., 2014; Kooloos et al., 2020).

In this context, structuring learning to include reflection and metacognitive regulation is increasingly recognised as a critical dimension of effective pedagogy. Reflection allows learners to evaluate what they know, how they learned, and what remains unclear. For example, Lew & Schmidt (2011) found that reflection journal writing is associated with improved academic achievement because it prompts students to review strategies, connect new content to prior knowledge, and monitor their own learning processes. When students reflect systematically, the processes of elaboration and consolidation are more likely to occur, thereby facilitating deeper understanding and retention (Roediger & Butler, 2011).

One pedagogical technique that has gained attention for its capacity to formalise reflection is the *reflective learning journal*. A learning journal is a structured written record in which students document their reflections on key concepts learned, challenges encountered, strategies applied, and plans for improvement (Alt et al., 2022). Studies indicate that when journal writing is combined with prompts, scaffolding, and feedback, it can enhance metacognitive awareness, promote self-regulated learning, and lead to improved cognitive outcomes (Ahmed, 2019). Moreover, a recent meta-analysis confirmed that reflective interventions yield significant positive effects on academic achievement across contexts (Zhai et al., 2023).

Despite a substantial body of empirical and theoretical work demonstrating the benefits of reflective journal writing, a critical research gap remains insufficiently addressed. Existing scholarship has predominantly examined reflective journaling within higher education and professional training settings such as pre-service teacher preparation programs and health sciences education where learners possess more advanced metacognitive skills and greater familiarity with reflective writing practices (Alt et al., 2022; Mohammad & Jado, 2015). As a result, current knowledge is disproportionately derived from adult learners, raising questions about its generalizability to adolescents in secondary schools, who differ significantly in cognitive development, self-regulation capacity, and instructional needs.

More importantly, very few studies have rigorously investigated the effects of learning journals in high school science classrooms, particularly with respect to the dual outcome of cognitive learning and long-term retention. Most existing research in secondary contexts examines only short-term achievement or descriptive improvements in engagement, leaving unresolved whether reflective journals can strengthen the durability of scientific knowledge over time. This gap is notable because retention – a central issue in science education – often declines rapidly when instruction is lecture-dominated and does not provide mechanisms for active recall or metacognitive processing.

An additional layer of uncertainty concerns how journaling should be implemented in high school settings. Research increasingly emphasizes that the effectiveness of reflective journals is not inherent to the activity itself but depends critically on the quality of prompts, the presence of scaffolding, and especially the provision of targeted teacher feedback (Pieper et al., 2021). Studies show that when journals are assigned without structure or meaningful feedback, their impact on both learning and retention becomes weak or negligible (Hübner et al., 2010). However, the interaction between journaling, teacher feedback, and dual learning outcomes has not been systematically examined in secondary-level science instruction, leaving a significant gap in our understanding of the mechanisms through which journals may (or may not) improve students' cognitive performance and memory retention.

In the context of high school biology where abstract concepts, complex processes, and terminology-heavy materials often challenge students' comprehension this research gap becomes particularly consequential. Preliminary observations at SMA Negeri 1 Tinambung revealed classroom practices dominated by lectures, minimal opportunities for students to reflect on their understanding, and a substantial proportion of learners failing to meet minimum mastery criteria. These conditions highlight an urgent pedagogical need for strategies that support active meaning-making while simultaneously strengthening the retention of scientific knowledge beyond immediate testing.

To address these gaps, the present study integrates structured reflective learning journals with teacher feedback in senior high school biology instruction. By inviting students to articulate their understanding, identify challenges, and plan improvements, while enabling teachers to respond with targeted guidance, this study evaluates whether structured journaling can effectively enhance both cognitive learning outcomes and delayed retention. The explicit examination of these dual outcomes in a secondary science context constitutes the core novelty of the research, offering evidence where current literature remains limited, fragmented, or inconclusive.

By situating the intervention within a high school biology classroom and pairing journal writing with teacher feedback, this study contributes to the literature by bridging the gap between higher-education research on reflection and secondary-school contexts. The findings can inform both theory and practice: theoretically by advancing understanding of how reflective journal writing influences metacognition, encoding, and retrieval; practically by offering science teachers an evidence-based strategy to improve both students' learning performance and retention of knowledge.

Against this backdrop, the principal research question addressed in this study is: *Does the implementation of learning journals have a significant positive effect on students' cognitive learning outcomes and knowledge retention in high school biology?* The hypothesis proposes

that the implementation of reflective learning journals will have a significant positive effect on students' cognitive achievements and long-term knowledge retention.

## **B. Methods**

### **1. Research Design**

This study employed a quasi-experimental design using a *pretest-posttest-retest control group design*. This approach was chosen to compare students' cognitive learning outcomes and knowledge retention between the experimental group, which received the treatment, and the control group, which followed conventional instruction. The treatment consisted of implementing learning journals as a reflective learning strategy in biology classes. This design allowed the researcher to measure both the immediate and delayed effects of the intervention on students' cognitive performance and retention levels.

### **2. Participants**

The participants comprised 64 Grade XI MIA students from SMA Negeri 1 Tinambung during the 2023/2024 academic year. A purposive sampling technique was employed to select two intact classes that met specific predetermined criteria relevant to the study's objectives. These criteria included: (a) having the same biology teacher, (b) following an identical curriculum structure, (c) demonstrating comparable academic ability based on the previous semester's biology grades, and (d) exhibiting similar class size and demographic composition. Based on these considerations, Class XI MIA 2 (32 students) was assigned as the experimental group, while Class XI MIA 1 (32 students) served as the control group. The students were between 16 and 17 years old and represented a typical gender distribution for the school (approximately 55% female and 45% male). Analysis of the prior semester's biology scores showed no statistically meaningful differences between the two classes (mean difference < 2 points on a 100-point scale), indicating comparable baseline academic ability. All participants had completed the foundational biology curriculum in Grade X, ensuring sufficient familiarity with the subject matter prior to the intervention.

### **3. Research Site and Duration**

The study was conducted at SMA Negeri 1 Tinambung, West Sulawesi, Indonesia, during the first semester of the 2023/2024 academic year (October-November 2024), conducted over a period of 6 weeks. The school was selected due to its implementation of active learning policies and accessibility for consistent classroom observation.

#### 4. Research Instruments

Four primary instruments were used in this study:

- a. Lesson Plans (RPP) – developed to ensure that the learning journal strategy was systematically integrated into classroom activities and aligned with the learning objectives.
- b. Cognitive Learning Achievement Tests (Pretest and Posttest) – The cognitive learning achievement tests consisted of 20 multiple-choice items designed to assess higher-order and lower-order thinking skills across Bloom’s taxonomy (C1–C5: remembering, understanding, applying, analyzing, and evaluating). Content validity was established through expert review by two expert reviewer, who evaluated item relevance, cognitive alignment, and language clarity. Reliability analysis using Cronbach’s Alpha demonstrated acceptable internal consistency for both the pretest ( $\alpha = 0.81$ ) and the posttest ( $\alpha = 0.86$ ), indicating that the instruments were psychometrically stable for measuring students’ cognitive performance.
- c. Knowledge Retention Test – The retention test comprised 20 multiple-choice items administered two weeks after the posttest to measure students’ long-term retention of the same instructional content. The retention test used the exact same set of items as the posttest, a standard procedure in retention research to ensure that differences in scores reflect memory decay rather than variations in test difficulty. Reliability for the retention test was also assessed using Cronbach’s Alpha and yielded a coefficient of  $\alpha = 0.84$ , indicating strong internal consistency. Because the item set was identical to the posttest, construct equivalence across testing intervals was inherently maintained.
- d. Learning Journal Sheets – The learning journal sheets served as the primary intervention instrument for the experimental group. Students completed a structured reflective journal at the end of every lesson, documenting their understanding, questions, and learning strategies. Each journal entry followed a standardized prompt format to ensure consistency and to guide students toward meaningful reflection. The journal sheet consisted of four core prompts: (1) “What key concepts did I learn today?” (2) “Which parts of the lesson were difficult for me, and why?” (3) “What strategies did I use to understand the material?” and (4) “What will I do differently next time to improve my learning?” These reflective prompts were designed to activate metacognitive processes such as monitoring, evaluation, and planning.

To enhance transparency and quality of feedback, teachers used a scoring rubric consisting of three criteria: (a) completeness, referring to whether all journal prompts were addressed; (b) depth of reflection, including accuracy of concept explanation and clarity in identifying difficulties; and (c) action planning, referring to students’ ability to propose realistic steps for improvement. Feedback was provided in the form of short written comments directly on the journal sheets,

focusing on concept clarification, motivational cues, and suggestions for better learning strategies. Two sample journal prompts are provided below:

Example Prompt 1:

*“Explain in your own words one concept you understood well today. Provide an example to show how you would apply it.”*

Example Prompt 2:

*“Identify one part of the lesson you found challenging. Describe how you tried to overcome this difficulty and what support you might need in the next session.”*

These structured prompts and feedback mechanisms ensured that journal writing functioned not merely as a recording task but as a scaffolded reflective practice aimed at strengthening cognitive learning and retention.

## 5. Research Procedures

The research was conducted in three main phases:

### *Preparation Phase*

- 1) Conducted interviews with biology teachers to identify instructional problems related to students’ engagement and retention.
- 2) Determined the study population and selected sample classes through coordination with the school administration.
- 3) Developed lesson plans, learning journals, and test instruments (pretest, posttest, and retest), followed by expert validation and revisions.

### *Implementation Phase*

- 1) Administered a pretest to both groups to assess students’ prior cognitive understanding.
- 2) Conducted the learning intervention using learning journals in the experimental group, whereas the control group using traditional instruction. Traditional instruction in this study referred to teacher-centered learning in which the teacher delivered material through lectures, textbook-based explanations, and question-answer sessions without the use of reflective writing activities. Both groups received eight lessons over a four-week period, with two lessons per week. In the experimental group, students wrote in their learning journals at the end of every lesson, documenting key concepts, personal reflections, difficulties encountered, and questions for further clarification. The teacher provided written formative feedback on each journal entry within 24 hours, focusing on three criteria: (1) accuracy of conceptual understanding, (2) clarity and completeness of reflection, and (3) connection between prior knowledge and newly learned content. In contrast, students in the control group completed only the standard lesson activities and did not engage in journaling or receive reflective feedback from the teacher.
- 3) Administered a posttest immediately after instruction to measure students’ cognitive learning outcomes.

- 4) Administered a retest two weeks later to measure the degree of knowledge retention.

*Final Phase*

- 1) Collected and processed all quantitative data using SPSS version 28.0.
- 2) Conducted descriptive statistics, assumption tests (normality and homogeneity), and inferential analysis (MANOVA) to examine the effect of the learning journal intervention on cognitive learning and retention.

**6. Data Analysis**

Data analysis was carried out using both descriptive and inferential statistical techniques.

- a. Descriptive Analysis was used to present the mean, standard deviation, and distribution patterns of students’ learning outcomes and retention scores.
- b. Inferential Analysis was conducted using Multivariate Analysis of Variance (MANOVA) at a significance level of 0.05 to test the research hypotheses. Data were considered normally distributed and homogeneous when the *p*-value exceeded 0.05. MANOVA was selected because it allows simultaneous testing of multiple dependent variables – cognitive learning outcomes and knowledge retention thus providing a more robust interpretation of the intervention effects.

**C. Results and Discussion**

**1. Results**

a. Descriptive Analysis

The descriptive analysis examined students’ cognitive learning outcomes and knowledge retention across experimental and control groups. Both groups consisted of 32 students each. The control group was taught using conventional methods, while the experimental group was taught using conventional instruction supported by reflective learning journals.

**Table 1. Descriptive Analysis Results of Cognitive Learning Outcomes**

Statistics	Number of Data (N)	Minimum Score	Maximum Score	Mean	Standard Deviation
Experimental Pretest	32	15	70	40.47	12.072
Experimental Posttest	32	60	90	75.63	7.042
Control Pretest	32	15	50	32.66	11.143
Control Posttest	32	35	75	59.84	12.345

For cognitive learning outcomes, the pretest and posttest results showed a marked improvement in both groups, with the experimental group outperforming the control

group. The mean pretest score in the control class was 32.66, increasing to 59.84 on the posttest. In contrast, the experimental class achieved a pretest mean of 40.47, which increased substantially to 75.63 after the intervention. The posttest mean difference indicates a significant gain in cognitive performance among students who engaged in reflective journal writing compared to those in traditional instruction.

**Table 2. Distribution of Cognitive Learning Outcomes in the Control Class**

Interval	Category	Cognitive Learning Outcomes			
		Pretest		Posttest	
		F	Percentage (%)	F	Percentage (%)
81-100	Very high	0	0	0	0
61-80	High	0	0	12	38
41-60	Moderate	8	25	18	56
21-40	Low	15	47	2	6
0-20	Very low	9	28	0	0
Total		32	100	32	100

**Table 3. Distribution of Cognitive Learning Outcomes in the Experimental Class**

Interval	Category	Cognitive Learning Outcomes			
		Pretest		Posttest	
		F	Percentage (%)	F	Percentage (%)
81-100	Very high	0	0	13	41
61-80	High	1	3	19	59
41-60	Moderate	15	47	0	0
21-40	Low	13	41	0	0
0-20	Very low	3	9	0	0
Total		32	32	100	32

The categorical distribution further supports these findings. In the control group, the majority of students' scores fell within the *medium* and *high* categories after instruction, while in the experimental group, most students achieved *high* and *very high* scores in the posttest. Notably, 41% of students in the experimental group reached the *very high* category, whereas no students in the control group reached that level. These results suggest that the integration of learning journals not only improved performance but also elevated students to higher levels of cognitive achievement.

### Retention Test Results

**Table 4. Descriptive Analysis Results of Students' Retention Data**

Statistics	Number of Data (N)	Minimum Score	Maximum Score	Mean	Standard Deviation
Experimental class retention	32	40	75	60.94	9.456
Control class retention	32	60	95	76.25	8.132

Knowledge retention was assessed two weeks after the completion of instruction. The mean retention score for the control group was 60.94, whereas the experimental group achieved a higher mean of 76.25. This difference suggests that the reflective journal approach contributed to stronger long-term memory retention.

**Table 5. Distribution of Students' Retention in the Control Class**

Retention (R) %	Category	Frequency	Percentage (%)
R ≥ 70	High	9	28.1
60 < R < 70	Moderate	3	4.4
R ≤ 60	Low	20	62.5
Total		32	100

**Table 6. Distribution of Students' Retention in the Experimental Class**

Retention (R) %	Category	Frequency	Percentage (%)
R ≥ 70	High	29	90.6
60 < R < 70	Moderate	2	26.3
R ≤ 60	Low	1	3.1
Total		32	100

In the control class, 62.5% of students were categorized as *low retention*, 9.4% as *moderate*, and 28.1% as *high*. Conversely, in the experimental group, 90.6% of students were categorized as *high retention*, with only one student (3.1%) in the *low retention* category. These results demonstrate that the use of reflective learning journals effectively enhanced students' ability to retain biological concepts over time.

### Assumption Testing

Prior to hypothesis testing, normality and homogeneity tests were conducted. The Shapiro-Wilk normality test results showed that all variables were normally distributed ( $p > 0.05$ ). The Levene's test for homogeneity also confirmed equal variances between groups ( $p > 0.05$ ). Thus, the data met the assumptions required for multivariate analysis.

**Table 7. Normality Test Results**

variable	sig.		description
	control	experimental	
cognitive learning outcomes	0.389	0.142	normally distributed
retention results	0.314	0.118	normally distributed

**Table 8. Homogeneity Test Results**

Variable	Sig.		Description
	Control	Experimental	
Cognitive learning outcomes	0.906	0.079	Homogeneous variance
Retention results	0.584	0.257	Homogeneous variance

## Hypothesis Testing

A Multivariate Analysis of Variance (MANOVA) was used to determine the effect of learning journal implementation on both cognitive learning outcomes and knowledge retention. The MANOVA results revealed a significant multivariate effect between the experimental and control groups, with a significance value of  $p = 0.000 (< 0.05)$ . Therefore, the null hypothesis ( $H_0$ ) was rejected, indicating that the application of reflective learning journals significantly influenced both dependent variables.

**Table 9. MANOVA Test Results for Experimental and Control Classes**

Variable	Class	df	Sig.
Cognitive learning outcomes and retention	Experimental	1	0.000
Cognitive learning outcomes and retention	Control	1	0.000

Overall, the findings indicate that integrating reflective learning journals into biology instruction produced substantial improvements in both cognitive learning outcomes and knowledge retention compared to conventional teaching. Students who engaged in reflective writing not only performed better immediately after instruction but also demonstrated stronger memory retention two weeks later. This suggests that reflective journaling serves as an effective pedagogical tool to promote meaningful learning, deeper understanding, and sustained cognitive engagement.

## Discussion

This study found that students in the experimental class (who used structured learning journals and received teacher feedback) improved significantly more on posttest scores and maintained higher retest (two-week retention) scores than the control class (traditional instruction). These results indicate that learning journals, when implemented with clear guidance and feedback, support not only short-term gains in understanding but also consolidation of knowledge over time (Alt et al., 2022; Zhai et al., 2023).

The findings of this study are also consistent with research conducted within the context of secondary education and biology learning in Indonesia. Several local studies have reported that learning journals effectively enhance student engagement, metacognitive awareness, and academic achievement when implemented in a structured and systematic manner (Bahri et al., 2020; Septiyana et al., 2013). Planned implementation—including clear journal formats, assessment rubrics, writing frequency, and feedback procedures—appears to be a key determinant of successful application at the high school level.

From a cognitive mechanism perspective, written reflection facilitates self-regulation

and learning strategies that promote deeper information processing and understanding (Aydoğmuş & Kurnaz, 2022; Zarestky et al., 2022). Meta-analytic and review-based evidence further indicates that interventions fostering metacognition and self-regulated learning strategies are generally positively associated with academic improvement, although effect sizes vary depending on the research design and educational context (Alt et al., 2022; Zhai et al., 2023). Moreover, studies examining retention variability suggest that retention is also influenced by the characteristics of the learning material, the cognitive level of assessment items, and the timing of the retention test—factors that must be considered when interpreting differences in retention scores across groups (Csaba et al., 2025; Kooloos et al., 2020).

The observed effects can be explained by several established mechanisms:

- a. Metacognitive regulation. Writing reflective entries prompts learners to monitor comprehension, identify gaps, and plan corrective strategies—processes central to self-regulated learning. This metacognitive engagement leads to better encoding and consolidation of material (Alt et al., 2022; Nückles et al., 2020; Udvardi-Lakos et al., 2023).
  - b. Elaboration and generative processing. Producing written reflections requires students to reorganize and elaborate on new information, linking it to prior knowledge; elaborative processing strengthens memory traces and facilitates later retrieval (Hübner et al., 2010; Weinstein & Mayer, 1983).
  - c. Retrieval practice and reconstruction. When students summarize or explain content in journals, they practice retrieval in a low-stakes context; repeated retrieval enhances retention (Kooloos et al., 2020; Zhai et al., 2023).
  - d. Feedback-mediated improvement. Teacher comments on journals help correct misconceptions and scaffold deeper reflection, increasing the likelihood that students adopt more effective cognitive strategies (Pieper et al., 2021; Zhang, 2023). Our field interviews corroborated that teacher feedback made students' reflections more diagnostic and actionable, which likely amplified the intervention's benefits.
- b. These mechanisms are supported across diverse empirical studies showing that reflective writing and guided journaling foster metacognition, elaboration, and sustained learning (Murillo-Llorente et al., 2021; Tsingos-Lucas et al., 2017; Walker, 2006).

Our findings align with multiple international and national studies and syntheses that report positive effects of reflective journals or structured reflection on academic achievement and retention (Alt et al., 2022; Artioli et al., 2021; Chang, 2019; Everett, 2013; Hübner et al., 2010; Lim et al., 2022; Mohammad & Jado, 2015; Murillo-Llorente et al., 2021; Pieper et al., 2021; Tsingos-Lucas et al., 2017; Udvardi-Lakos et al., 2023; Walker, 2006; Zhai et al., 2023). Several meta-analytic/twinned reviews report moderate to large effect sizes for reflective interventions on learning outcomes, particularly when reflective tasks are structured and supported by feedback (Guo,

2022; Zhai et al., 2023).

While the overall pattern is positive, the literature emphasizes boundary conditions. Studies show that the quality of journaling (depth of reflection), instructional support (prompts, scaffolds), and teacher feedback are decisive moderators: unstructured or unsupported journal writing often yields weak or inconsistent effects (Gentner et al., 2024; Hübner et al., 2010; Nückles et al., 2020). Our study's success was likely supported by (a) explicit journal prompts, (b) teacher feedback, and (c) integration with lesson plans—factors shown to increase journal efficacy (Gentner et al., 2024; Pieper et al., 2021).

Not all studies report unequivocal benefits. Contextual or methodological differences produce variability. For example, some research (including local reports such as Faisal et al., 2018) found no significant effect of journal interventions when prompts were weak, feedback absent, or intervention duration short. Meta-analytic discussions also note heterogeneity of effects across settings, underscoring that reflective writing is effective if the intervention includes scaffolding and responsive feedback (Guo, 2022; Hübner et al., 2010). These contrasting results highlight the need to attend to implementation fidelity and mediator variables.

Another studies have reported differing or weaker effects on academic outcomes under certain conditions. For instance, some research on student-centered learning methods or other pedagogical interventions has found that such approaches do not always yield long-term effects on academic achievement or retention—their effectiveness often depends on implementation quality, intervention duration, learner characteristics, and the quality of feedback provided. Therefore, inconsistencies in the literature highlight the importance of robust intervention design, including journal writing training, clear reflection guidelines, and structured feedback mechanisms, as well as measuring retention over appropriate time intervals. Studies that reject or report non-significant effects of similar interventions provide critical context for interpreting the present findings and underscore the conditional nature of implementation factors (Kjærgaard et al., 2024; Maanen et al., 2024).

The present findings suggest practical recommendations for practitioners: design learning journals with explicit prompts that elicit elaboration and metacognitive statements; provide timely, constructive feedback on students' entries; and incorporate journaling as a routine formative activity rather than a one-off task. Such practices are low-cost and scalable and can be incorporated into routine biology instruction to strengthen both immediate learning and longer-term retention.

Limitations include the single-school sample, a two-week retention interval, and reliance on multiple-choice instruments. Future research should (a) replicate across diverse schools and subjects, (b) examine longer retention intervals (e.g., 1–3 months),

(c) analyze the content of journal entries to link reflection depth to outcomes, and (d) experimentally manipulate feedback quality and prompt type to identify causal moderators (Gentner et al., 2024; Nückles et al., 2020).

#### **D. Conclusions**

This study set out to examine whether the implementation of learning journals as a structured reflective strategy, supported by teacher feedback, could enhance students' cognitive learning outcomes and knowledge retention in senior high school biology. The central aim was to determine whether reflective journal writing, when systematically integrated into the learning process, offers measurable academic benefits beyond those produced by conventional instructional methods. The findings provide clear empirical support for this proposition. Statistical analysis using MANOVA demonstrated a significant multivariate effect of the intervention on both cognitive achievement and retention (Sig. = 0.000 < 0.05), indicating that students who engaged in reflective journal writing performed substantially better than those in the control group. These results confirm that reflective learning journals constitute an effective pedagogical tool for deepening students' cognitive processing of subject matter. By articulating their understanding, identifying difficulties, and revisiting key concepts through structured prompts, students were able to reinforce their comprehension and consolidate information more effectively. The substantial retention gains observed in the experimental group further suggest that reflective writing supports not only immediate learning but also the stabilization of knowledge in memory, offering a mechanism for sustained academic performance. Theoretically, this study strengthens the argument that metacognitive engagement – particularly through reflective writing – plays a critical role in promoting deeper learning and durable knowledge retention. The findings align with learning theories that emphasize active meaning-making, self-regulation, and metacognitive monitoring as foundational processes for higher-order cognitive development. Practically, the implementation of structured learning journals represents a low-cost, scalable strategy that teachers can readily integrate into existing curricula. The approach is flexible, requires minimal technological resources, and provides teachers with valuable insight into students' thinking processes, thereby enhancing instructional responsiveness. Overall, the study offers robust evidence that reflective learning journals can meaningfully improve educational outcomes in secondary science classrooms.

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