



Effects of structured note-taking on concept retention in Grade 11 Physics: A quasi-experimental study

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ABSTRACT

Retaining Physics concepts continues to be a challenge for many learners because the discipline requires understanding abstract ideas, mathematical relationships, and interconnected principles. Students often experience difficulty sustaining understanding of foundational principles without structured instructional support. This study evaluated the effectiveness of structured note-taking as an instructional strategy in improving concept retention among Grade 11 students in Physical Science. A quasi-experimental design was utilized in which two intact classes were randomly designated as the experimental and control groups. Both groups underwent a validated assessment before and after a four-week instructional period. The experimental group used note-taking templates incorporating graphic organizers, guided analytical formats, and structured summary components, whereas the control group participated in regular instructional practices. Analysis indicated both groups had comparable levels of performance prior to implementation of the strategy. Following the four-week instructional period, the experimental group exhibited substantial gains in concept retention, and post-test performance was significantly higher compared to the control group. The magnitude of the observed effects suggests a meaningful instructional benefit. The findings suggest that structured note-taking may support improved retention of Physics concepts in secondary classrooms. As a classroom-based and low-cost instructional strategy, structured note-taking shows potential as a practical scaffold for strengthening students' consolidation and retrieval of complex scientific content.

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INTRODUCTION

Physics is a foundational discipline in science education, fostering analytical reasoning, quantitative problem-solving, and conceptual understanding. Despite its importance, students frequently encounter difficulty retaining Physics concepts over time. The discipline involves abstract principles, mathematical relationships, and interconnected ideas that require sustained cognitive processing. When learners focus primarily on procedural steps without fully understanding underlying principles, retention weakens and knowledge remains fragmented. Students' attitudes toward Physics have also been shown to influence persistence and sustained engagement with scientific concepts (Mabee et al., 2021; Mboniyirivuze et al., 2021).

Concept retention refers to the ability to recall and apply previously learned knowledge after instruction has concluded. Retention is particularly critical in Physics because topics are hierarchically structured, with advanced concepts building upon foundational understanding. When earlier ideas are not consolidated, subsequent learning becomes increasingly difficult. Research indicates that learners forget a substantial portion of newly acquired information without structured reinforcement (Jiwane, 2019; Achor & Gbadamosi, 2020). In Physics classrooms, diminished retention has been linked to cognitive overload, misconceptions, and insufficient conceptual integration (Assem et al., 2023).

Instructional strategy plays a central role in addressing this challenge. Approaches such as flipped classrooms (Ugwuanyi et al., 2020), multimedia integration (Tugirinshuti et al., 2024), and inquiry-based instruction (Eviota & Liangco, 2020) have demonstrated improvements in engagement and achievement. However, many of these strategies require additional technological resources or substantial restructuring of instructional practice. Similarly, design-based and structured assignment approaches have shown promise in promoting retention and conceptual transfer in Physics education (Puente & Kroesen, 2020), yet they often demand extensive planning or resource adaptation. These considerations highlight the need for classroom-based strategies that are structured, scalable, and feasible within regular instructional time.

Structured note-taking offers a potentially practical alternative. This instructional strategy employs predefined templates that guide students in organizing key ideas, identifying conceptual relationships, and structuring analytical steps during instruction. Unlike unstructured note-taking, guided formats provide cognitive scaffolds that direct attention toward essential content and reduce disorganized processing. Grounded in Cognitive Load Theory (Paas & van Merriënboer, 2020), structured note-taking may help reduce extraneous cognitive load while supporting germane processing necessary for meaningful learning. Given that working memory capacity is closely associated with academic performance and conceptual understanding (Hu & Hu, 2023), instructional supports that optimize cognitive processing are particularly relevant in conceptually demanding subjects such as Physics.

By systematically organizing information, structured note-taking may strengthen encoding and facilitate retrieval of scientific concepts. Empirical research across disciplines indicates that organized and guided note-taking improves comprehension, recall, and academic performance (Salame & Thompson, 2020; Artz et al., 2022). Comparative analyses further suggest that structured formats promote stronger conceptual retention than conventional note-taking methods (Salem, 2020). Additional studies associate guided note-making with deeper engagement and improved learning outcomes (Thomas, 2021), and student perceptions indicate enhanced clarity and understanding when structured formats are used (Soumokol et al., 2021).

Despite this growing body of evidence, empirical research examining structured note-taking specifically within secondary Physics classrooms remains limited, particularly using quasi-experimental designs that focus explicitly on concept retention. Physics requires sequential reasoning, formula integration, and conceptual comparison, which may place distinct cognitive demands on learners. Systematic investigation of structured note-taking in this context is therefore warranted.

The study examined the effects of structured note-taking as an instructional strategy on concept retention in Grade 11 Physics by comparing students who implemented structured templates with those who received conventional instruction. By evaluating a classroom-based and low-cost strategy within regular instructional conditions, this study seeks to contribute empirical evidence to instructional practices aimed at strengthening conceptual retention in secondary science education.

OBJECTIVES OF THE STUDY

This study aimed to determine whether the use of structured note-taking during instruction leads to significant improvement in students' concept retention in Grade 11 Physics. Specifically, it sought to: examine whether students who implemented structured note-taking demonstrate significant gains from pre-test to post-test; and determine whether post-test performance differs significantly between students who used structured note-taking and those who received conventional instruction.

METHODS

The study adopted a quasi-experimental pretest-posttest design to evaluate the effect of structured note-taking on Physics concept retention among Grade 11 learners. The design was selected because intact classes were used and random assignment of individual students was impractical within the school setting. Two existing Grade 11 classes enrolled in Physical Science during the second semester of the academic year 2024–2025 participated in the study. The classes were selected through purposive sampling to preserve natural classroom structure and instructional continuity. Each class consisted of 26 students, resulting in a total of 52 participants. One class was designated as the experimental group and implemented structured note-taking during instruction, whereas the other functioned as the control group and followed regular classroom practices. Both groups were taught the same curriculum content, followed the same instructional schedule, and were allotted equivalent instructional time to ensure comparability.

Concept retention was measured using a researcher-developed multiple-choice assessment aligned with the Grade 11 Physical Science curriculum. The instrument covered core topics including force, energy, waves, electricity, and magnetism. Two parallel forms of the assessment (Form A and Form B) were developed to measure the same content domains and cognitive levels. Each set consisted of 30 multiple-choice items distributed according to a Table of Specifications (TOS) aligned with the learning competencies to ensure adequate content representation (Brookhart & Nitko, 2014). Content validity was established through expert evaluation, with three science educators reviewing both forms for alignment with curriculum standards, clarity of wording, conceptual accuracy, and appropriateness of difficulty level. Revisions were made based on their recommendations prior to administration. Internal consistency reliability was examined using the Kuder–Richardson Formula 20 (KR-20), yielding coefficients of .76 for Form A and .73 for Form B, indicating acceptable reliability. Form A was administered as the pre-test and Form B as the post-test to minimize testing effects associated with repeated exposure to identical items.

The structured note-taking strategy was implemented over a four-week instructional period. The experimental group utilized structured note-taking templates specifically designed for Physics instruction. These templates incorporated graphic organizers, guided analytical formats for problem-solving, concept comparison tables, and structured summary sections to support systematic organization and processing of information. The control group received teacher-led instruction using conventional note-taking practices without structured templates. Instructional pacing, content coverage, and assessment schedules were maintained consistently across both groups to reduce instructional variability.

To establish baseline comparability, a pretest was administered to students in both groups before the implementation of the strategy. Following the four-week instructional period, a post-test was administered under standardized classroom conditions. Data were analyzed using the Statistical Package for the Social Sciences (SPSS).

Measures of central tendency and variability were generated to describe students' performance. Independent-samples t-tests were conducted to examine differences between groups, and a paired-samples t-test was used to assess within-group improvement in the experimental class. All statistical tests were evaluated at a significance level of .05. Prior to inferential analysis, data distribution was evaluated through the Shapiro–Wilk test, whereas equality of variances was verified using Levene's test. Inspection of skewness and kurtosis values indicated no substantial violations of parametric assumptions.

Permission to conduct the study was obtained from the school administration. Students were informed of the study's purpose and assured that participation would not affect their academic standing. Participation was voluntary, and data were treated confidentially and reported in aggregate form to protect participant identity.

RESULTS AND DISCUSSION

To examine the effects of structured note-taking as an instructional strategy on concept retention, statistical analyses were conducted to evaluate baseline equivalence, within-group improvement, and post-implementation differences between groups.

Pre-Test Performance Prior to Implementation

To describe students' initial level of concept retention before implementation of the instructional strategy, pre-test scores of both groups were analysed.

Table 1. Pre-Test Distribution of Scores for Control and Experimental Groups

Score Range	Control		Experimental	
	Frequency	Percentage	Frequency	Percentage
25 - 30	0	0%	0	0%
19 - 24	10	38.46%	5	19.23%
13- 18	11	42.31%	12	46.15%
7 – 12	5	19.23%	9	34.62%
1 - 6	0	0%	0	0%
Mean	16.27		14.12	
Standard Deviation	4.53		4.13	
Verbal Interpretation	Fairly Satisfactory		Fairly Satisfactory	

Legend: Very High Retention (25-30); High Retention (19-24); Moderate Retention (12-18); Low Retention (7-12); Very Low Retention (0-6)

Pre-test results indicate that most students in both groups were concentrated within the moderate retention range (13–18). A smaller proportion of students achieved scores within the high retention category (19–24), and no students in either group reached the very high retention level. These distribution patterns suggest that both classes demonstrated comparable levels of conceptual understanding prior to implementation of the structured note-taking strategy.

Baseline results indicate that students had only partially consolidated the assessed Physics concepts despite prior exposure to the content. This finding suggests that while foundational understanding had been established, retention of key concepts remained limited, highlighting the challenges learners often encounter when processing and retaining

abstract scientific ideas.

Baseline differences between the control and experimental groups were examined using an independent-samples t-test based on the pretest scores. The control group obtained a mean pre-test score of 16.27 (SD = 4.53), while the experimental group obtained a mean of 14.12 (SD = 4.13). The independent-samples t-test indicated that the difference between groups was not statistically significant, $t(50) = 1.79$, $p = .080$. This outcome indicates that the groups began the study with comparable retention levels.

The absence of a significant baseline difference strengthens the validity of subsequent comparisons by reducing the likelihood that post-intervention differences can be attributed to pre-existing variations in students' retention levels. Moreover, the moderate retention levels observed across both groups are consistent with previous research indicating that secondary students often encounter difficulty sustaining understanding of Physics concepts without structured instructional support. Calderon (2023) noted that learners frequently struggle to retain scientific concepts over time, while Catarina (2022) reported that long-term retention remains a persistent challenge even when students initially demonstrate conceptual understanding. This observation is further supported by Assem et al. (2023), who identified misconceptions and difficulties in conceptual integration as persistent barriers to sustained learning in Physics. These findings suggest that strategies designed to promote organization, review, and meaningful processing of information may be necessary to support deeper and more durable retention of Physics concepts.

Post-Test Performance After Implementation of the Instructional Strategy

To examine students' level of concept retention following the four-week instructional period, post-test scores of the control and experimental groups were analyzed.

Table 2. Post-Test Distribution of Scores for Control and Experimental Groups

Score Range	Control		Experimental	
	Frequency	Percentage	Frequency	Percentage
25 - 30	0	0%	6	23.08%
19 - 24	11	42.31%	19	73.08%
13- 18	13	50%	1	3.84%
7 – 12	2	7.69%	0	0%
1 - 6	0	0%	0	0%
Mean	17.62		22.54	
Standard Deviation	3.42		2.72	
Verbal Interpretation	Moderate Retention		High Retention	

Legend: Very High Retention (25-30); High Retention (19-24); Moderate Retention (12-18); Low Retention (7-12); Very Low Retention (0-6)

Notable differences in retention levels were observed following implementation of the structured note-taking strategy. The experimental group demonstrated a pronounced shift toward the higher retention categories, with most students classified within the high and very high retention ranges. In contrast, the control group remained concentrated within the moderate and high retention categories, and no student attained the very high retention level. The experimental

group also achieved a substantially higher mean score ($\bar{X} = 22.54$, $SD = 2.72$) than the control group ($\bar{X} = 17.62$, $SD = 3.42$), reflecting stronger overall retention of the assessed Physics concepts.

The observed distributional shift suggests that structured note-taking may have supported learners in organizing, processing, and retaining information more effectively than conventional instruction alone. While both groups were exposed to the same content during the instructional period, students who utilized structured note-taking demonstrated a greater tendency to move beyond moderate retention levels and into the higher performance categories. This finding implies that the strategy may have facilitated deeper consolidation of concepts rather than merely improving short-term recall.

The results are consistent with previous research indicating that organized and guided note-taking promotes improved retention by encouraging systematic processing and organization of information (Artz et al., 2022; Salem, 2020). In Physics education, where learners are often required to connect abstract concepts, formulas, and scientific principles, structured note-taking may serve as a cognitive scaffold that helps students identify essential relationships among ideas. By externalizing information into organized formats, learners may be better able to review, retrieve, and integrate concepts over time.

From the perspective of Cognitive Load Theory, structured note-taking may help reduce extraneous cognitive load by directing learners' attention toward key concepts and relationships while minimizing the mental effort required to organize information independently (Paas & van Merriënboer, 2020). This may be particularly important in Physics, where students frequently encounter conceptually demanding content that requires simultaneous processing of multiple representations and ideas. The concentration of high-performing students within the experimental group therefore suggests that structured note-taking may not only enhance retention but also support more efficient learning of complex scientific concepts.

These findings contribute to the growing body of evidence supporting the use of structured learning supports in science education. The results suggest that relatively simple instructional strategies, such as guided note-taking templates, can meaningfully improve students' retention of Physics concepts and may provide teachers with a practical strategy for addressing persistent difficulties in long-term concept retention.

Within-Group Improvement in the Experimental Class

Improvement in concept retention among students in the experimental group was assessed through a comparison of pre-test and post-test scores using a paired-samples t-test.

Table 3. Paired-Samples t-Test Comparing Pre-Test and Post-test Scores of the Experimental Group

Assessment	N	Mean	SD	t(25)	p	Cohen's d
Pre-test	26	14.12	4.13			
Post-test	26	22.54	2.72	-7.12	<.001	2.41

The experimental group's mean score increased from 14.12 ($SD = 4.13$) on the pre-test to 22.54 ($SD = 2.72$) on the post-test. The paired-samples t-test indicated that this increase was statistically significant, $t(25) = -7.12$, $p < .001$. The effect size (Cohen's $d = 2.41$) indicates that the observed improvement was educationally meaningful, reflecting a substantial enhancement in students' ability to retain and retrieve Physics concepts following implementation of the structured note-taking strategy. Furthermore, the reduction in standard deviation from 4.13 to 2.72 indicates that student performance became more consistent over time, suggesting that the strategy may have benefited not only higher-performing learners but also students who initially demonstrated weaker retention.

The findings support previous research indicating that organized and guided note-taking promotes deeper processing of instructional content and strengthens retention. Salame and Thompson (2020) and Salame et al. (2024) reported that structured note-taking improves learners' ability to organize information, identify key concepts, and retain content over extended periods. Similarly, Trilipi et al. (2019) found that structured note-taking strategies incorporating visual organizers, keywords, and guided organization enhanced learners' retention by helping them process information more systematically. These findings are particularly relevant to the present study, in which students utilized structured note-taking templates designed to organize concepts and relationships within the lesson content.

The results also suggest that structured note-taking functioned as an effective instructional scaffold within the learning process. Beyond the note-taking templates themselves, opportunities for review, revision, and feedback may have reinforced retention by encouraging repeated engagement with key concepts. This is consistent with Jiwane (2019), who emphasized that reviewing and refining notes can strengthen learning and improve long-term retention. Although the present study did not directly measure cognitive processes, the substantial increase in retention scores provides evidence that structured note-taking supported meaningful learning and consolidation of Physics concepts within the observed instructional context.

Test of Significant Difference in Post-Test Scores

To determine whether structured note-taking was associated with differences in concept retention compared to conventional instruction, post-test scores of the control and experimental groups were analyzed using an independent-samples t-test.

Table 4. Independent-Samples t-Test Comparing Post-test Scores of the Control and Experimental Group

Group	N	Mean	SD	t(50)	p	Cohen's d
Control	26	17.62	3.42			
Experimental	26	22.54	2.72	-5.75	<.001	1.59

The experimental group obtained a higher mean post-test score ($\bar{X} = 22.54$, $SD = 2.72$) than the control group ($\bar{X} = 17.62$, $SD = 3.42$). The independent-samples t-test indicated that this difference was statistically significant, $t(50) = -5.75$, $p < .001$. Moreover, the large effect size (Cohen's $d = 1.59$) indicates that students who implemented structured note-taking demonstrated substantially higher levels of concept retention than those who received conventional instruction.

The observed difference suggests that the benefits of structured note-taking extended beyond normal classroom learning gains. Although both groups received the same instructional content, students who used structured note-taking consistently demonstrated stronger retention outcomes, as evidenced by their higher mean scores and greater concentration within the high and very high retention categories. These findings suggest that structured note-taking may support learners in organizing and revisiting information in ways that strengthen long-term retention of Physics concepts.

The findings align with Lichty (2022), who reported that note-taking strategies are most effective when they encourage learners to identify key ideas, organize information meaningfully, and regularly review content. In the context of Physics instruction, where learners must connect abstract concepts, scientific principles, and problem-solving processes, structured note-taking may provide a practical framework for supporting meaningful engagement with content rather than passive recording of information.

More importantly, the findings contribute to the growing body of evidence supporting structured note-taking as an instructional strategy in science education. While previous studies have generally emphasized its role in improving comprehension and academic performance, these results suggest that its benefits may also extend to strengthening long-term retention of Physics concepts among senior high school learners. The substantial difference in post-test performance between groups indicates that providing students with structured opportunities to organize, connect, and review information can promote more durable learning outcomes.

The findings also carry practical implications for classroom instruction. As a low-cost and easily implemented strategy, structured note-taking offers teachers a feasible means of improving retention outcomes without requiring extensive technological resources or major curricular modifications. Consistent with Gorospe and Abad (2023), the results suggest that active engagement through purposeful note-taking may contribute to stronger learning outcomes than more passive approaches to information acquisition. Consequently, structured note-taking may serve as an effective instructional scaffold for promoting retention and supporting meaningful learning in secondary Physics education.

CONCLUSION AND RECOMMENDATION

This study examined the effects of structured note-taking as an instructional strategy on concept retention in Grade 11 Physics using a quasi-experimental design. The findings indicated that students who implemented structured note-taking achieved significantly higher post-test scores compared to those who received conventional instruction. In addition to substantial within-group improvement in the experimental class, the between-group comparison revealed a large effect size favoring structured note-taking.

The results suggest that structured note-taking may function as more than a recording technique, serving instead as an instructional scaffold that supports organized processing of scientific content. Consistent with frameworks emphasizing explicit guidance and structured learning supports (Hornby & Greaves, 2022), the strategy appears to help learners organize key ideas and relationships within conceptually demanding material. Although the present study did not directly measure cognitive mechanisms, the observed retention gains are consistent with theoretical perspectives that highlight the importance of structured processing in supporting learning and consolidation.

From an instructional standpoint, structured note-taking represents a practical and low-cost strategy that can be integrated into regular classroom practice without substantial technological or curricular modification. Its observed association with improved retention in a content-intensive subject such as Physics suggests potential applicability in other domains where conceptual organization is essential.

The findings should be interpreted in light of several study limitations. The study was conducted using intact classes within a single school setting, which may limit generalizability. Although parallel forms were used to reduce testing effects, the duration of the study was limited to four weeks. Future research may examine the long-term sustainability of retention gains, replicate the study across diverse educational contexts, and explore how variations in structured templates influence learning outcomes. Additional investigations may also consider combining structured note-taking with complementary instructional strategies.

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