Society of Medical Education & Research

2022, Volume 2, Page No: 232-239
ISSN: 3108-4850

Annals of Pharmacy Education, Safety, and Public Health Advocacy

Evaluating the Impact of Notebooks on Lecture Reflection in Dental Pharmacology

Rami F. Saad[1], Nour A. Khalil[2], Lina M. Haddad[2]*, Samir Y. Hussein[2]

[1]Department of Public Health, Faculty of Medicine, University of Jordan, Amman, Jordan.
[2]Department of Pharmacy Practice, Faculty of Pharmacy, University of Jordan, Amman, Jordan.

***E-mail** ✉ lina.haddad@gmail.com

Abstract

In Japan, dental education primarily relies on lecture-based teaching using PowerPoint, with minimal active learning. This approach has limitations because students often remain passive recipients of information, highlighting the need for strategies that reinforce content retention. One widely recommended method is summarizing lecture material through note-taking. However, it is unclear whether taking notes directly contributes to better test performance. The current study aimed to assess the lecture notes produced by students, explore the relationships between note evaluation scores and academic performance, and provide insights into the practical utility of lecture notes in learning. Students newly enrolled in dental pharmacology were instructed to compile notes summarizing both lecture and practical session content. Upon completion of all sessions, students undertook multiple-choice objective tests and essay tests twice each as measures of learning outcomes. Lecture notes were permitted during the first essay test but prohibited in the second. The quality of lecture notes was assessed, and regression and correlation analyses were conducted to explore associations between note evaluation scores and test results.

Analysis of the multiple-choice tests revealed significant positive correlations between note evaluation scores and test performance for both the initial and subsequent tests. In contrast, essay test performance correlated positively with note quality only during the first test when notes were allowed. These results suggest that lecture notes are particularly effective during the initial "encoding" phase of memory formation, acting as an external repository for information and facilitating later recall. Utilizing lecture notes actively is beneficial for performance in multiple-choice assessments, such as those used in the Japanese national dental licensing examination. Additionally, incorporating notes in essay tests supports evaluation of students' capacity to construct coherent responses while recalling and applying learned content.

Keywords: Logical-thinking, Memory-creation process, Notebook, Dental pharmacology, Multiple-choice test, Essay test

Introduction

Students preparing for a career as dental practitioners must accurately understand and memorize content delivered during lectures and practical sessions. Mastery of this knowledge is critical for success in the national dental licensing examination. The process of forming long-term memory involves "encoding" information during study, "retention" to maintain it over time, and "recall" for later application [1]. The Japanese dental licensing examination requires flexible recall to answer diverse question types, which cannot be achieved through short-term memory alone. Consequently, daily study and repeated review are essential for consolidating knowledge in long-term memory.

Traditional lecture formats often render students passive learners, limiting the depth and clarity of content retention [2]. To address this, repeated review and reflection on study material is critical. One effective strategy is note-taking, which allows students to summarize lecture content in a form that supports encoding, retention, and subsequent recall [3–5]. While textbooks and instructor-provided materials contribute to

Access this article online https://smerpub.com/

Received: 14 August 2022; **Accepted:** 16 November 2022

How to cite this article: Saad RF, Khalil NA, Haddad LM, Hussein SY. Evaluating the Impact of Notebooks on Lecture Reflection in Dental Pharmacology. Ann Pharm Educ Saf Public Health Advocacy. 2022;2:232-9. https://doi.org/10.51847/NgMMMunvNI

encoding, research indicates that actively creating and reviewing personal notes produces superior short-term test performance compared with solely reviewing provided materials [6]. Note-taking also aids students in organizing knowledge systematically and enhances memory retrieval. Although prior studies suggest that note-taking supports memory retention, it is less effective for questions requiring inferential reasoning [7, 8]. Given that Japanese dental examinations emphasize memorization over inference, note-taking remains a highly suitable learning approach for dental students. Additionally, producing notes encourages logical thinking and reflection, further supporting memory recall. However, the quality of students' notes varies, and it remains unclear whether differences in note-taking ability correspond to differences in test performance.

Dental pharmacology requires comprehension of theoretical topics, such as drug metabolism, mechanisms of action, and adverse effects, along with practical knowledge of drugs used in diverse clinical scenarios. With the rapid expansion of pharmacological knowledge, students face a substantial volume of material to master. This study therefore aimed to investigate the relationship between lecture notes taken in dental pharmacology courses and memory consolidation. We evaluated the content quality of notes and analyzed their correlation with written test outcomes, providing insights into the effective use of lecture notes for educational guidance.

Materials and Methods

Descriptor definitions

Pretest: Written examination conducted before the term-end dental pharmacology assessment **(Table 1)**.

Table 1. Lecture and test schedule for the dental pharmacology class in the current case

Subject	Term
Orientation	
Lectures and practicum session	54 class units (32 lectures and 22 practicum sessions)
Collecting and scoring the notebooks	
↓	6 days
Return the notebooks	
↓	3 weeks
Pretest	
↓	1 week
Reviewing the pretest	3 class units
↓	2 weeks
Actual test	

Actual test

The written examination conducted at the conclusion of the dental pharmacology term served as the term assessment **(Table 1)**.

Multiple-choice objective test

This test consisted of multiple-choice questions designed to evaluate students' factual knowledge and comprehension without subjective judgment. Use of lecture notes was not permitted during these assessments.

Essay test

Students completed essay-style questions on selected dental pharmacology topics to assess their reasoning skills based on their knowledge and understanding. For the pretest essay, students were allowed to consult their lecture notes, whereas notes were prohibited during the actual test.

Participants

The study included 122 second-year students enrolled in the dental pharmacology course at Osaka Dental University during the 2022 academic year.

Lecture schedule

An overview of the dental pharmacology lecture and test timeline at Osaka Dental University is presented in **Table 1**. Prior to the start of lectures, students attended an orientation session on notebook use, during which each student received a designated notebook. The orientation covered the lecture and test schedule, and students were informed that their notebooks would be formally evaluated. They were advised that they could use their evaluated notebooks for the pretest, but not for the actual examination. Students participated in 54 class sessions (70 minutes each), comprising 32 lectures and 22 practical sessions, conducted from 29 September to 23 December 2022. Upon completion of all sessions, students' notebooks were temporarily collected for scoring and returned six days later. The pretest was administered three weeks after notebook return, followed by three class sessions dedicated to review, with the actual test conducted two weeks afterward.

Lecture notes

Students were encouraged to freely take notes during both lectures and practical sessions, with the objective of

summarizing key points to enhance understanding of dental pharmacology. Notes were required to be handwritten, and inclusion of copied text from lecture materials or peers' notes was prohibited. Notebooks were provided in advance and consistently used throughout the course; additional notebooks were supplied as needed. Students were responsible for managing their own notebooks and could revise them until the completion of all lectures and practicum sessions.

Evaluation of lecture notes

After all lectures and practical sessions were completed, students' notebooks were temporarily collected and assessed by two independent evaluators using a rubric comprising four criteria **(Table 2a)**. The first criterion assessed whether the notebook encompassed content from all 32 lectures, reflecting comprehensive understanding of material necessary for the Japan National Dental Examination. The second criterion evaluated the use of figures and tables, which facilitate comprehension and organization of complex pharmacological concepts. The third criterion measured the degree to which content was actively summarized, rather than passively copied from slides, reflecting deeper engagement with the material. The final criterion focused on the identification of key points, assessing whether essential content was emphasized and clearly highlighted. Scores were assigned based on the number of criteria met: 20 points for all four, 10 points for three, 5 points for two, 1 point for one, and 0 points if none were met **(Table 2b)**. To ensure scoring reliability, both evaluators independently assessed all notebooks. Discrepancies were resolved through discussion until a consensus was reached, guaranteeing fair and consistent evaluation.

Table 2. Evaluation rubric for lecture notes

Criteria	Evaluation
(a) Evaluation criteria	
Are all lecture contents covered in the notebooks?	Achieved/Not Achieved
Are figures and tables used in note-taking to enhance understanding and organization of content?	Achieved/Not Achieved
Are the lecture contents appropriately summarized?	Achieved/Not Achieved
Are important points emphasized and clearly highlighted (e.g., underlining, bolding, or color coding)?	Achieved/Not Achieved

Number of Criteria Achieved	Score
(b)Scoring rules	
4	20 points
3	10 points
2	5 points
1	1 point
0	0 points

To ensure that all students submitted their notebooks, each notebook was stamped before being returned. For the test in which notebook use was permitted, only notebooks bearing the confirmation stamp were allowed inside the examination room.

Written tests

Written assessments were administered twice: as a pretest and as the actual term test. While the pretest and actual test addressed the same concepts and used identical formats, the specific questions differed. Both tests covered content from all 54 class sessions, including 32 lectures and 22 practical sessions. The difficulty of the pretest and actual test was carefully calibrated to be comparable. Each testing session included a multiple-choice objective component, using answer sheets modeled after the national dental practitioner examination, and an essay component completed in longhand.

The pretest was conducted on January 6, 2023, two weeks after the completion of all 54 class sessions. Students first completed a 40-minute multiple-choice test, followed by a 10-minute break, and then a 30-minute essay test. For the essay portion of the pretest, students were allowed to consult their lecture notes, provided the notebooks had the confirmation stamp indicating prior evaluation.

The actual test was held on January 24, 2023, 19 days after the pretest. During this interval, three class sessions were conducted to review pretest questions, while no additional lectures were given, and students prepared independently for the actual test. The examination lasted 70 minutes, during which students completed both the multiple-choice and essay components without access to lecture notes. Each component was scored out of 100 points **(Table 3)**.

Table 3. Lecture note evaluation scores and pretest and actual test scores for the multiple-choice objective test and the essay test

	Note evaluation scores (maximum: 20 points)	Multiple-choice objective test scores (maximum: 100 points)		Essay test scores (maximum: 100 points)	
		Pretest	Actual Test	Pretest	Actual Test
Mean	8.1	74.0	76.6	56.5	39.9
Minimum	0	23	42	10	0
Maximum	20	99	98	100	100
Median	5.0	74	78	51	36
Standard deviation	6.04	15.53	11.18	22.13	29.39
Standard error	0.55	1.41	1.01	2.00	2.66

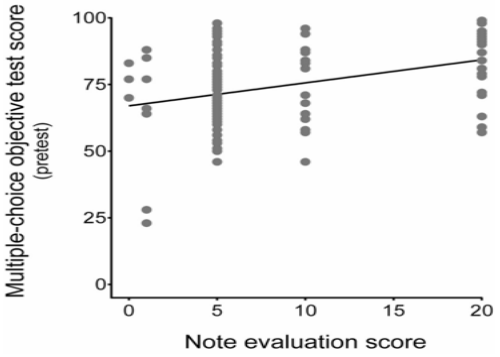
Data processing and statistical evaluation

The total scores were calculated by combining the points from the assessments with those assigned to the lecture note assessments. Graphical representations were generated and examined using GraphPad Prism (GraphPad Software, USA). For every pairwise comparison, linear regression was applied to assess the association between note assessment scores and exam performance, with the determination coefficient (R^2) computed accordingly. The R^2 value represents the proportion of variance in the outcome variable accounted for by the model.

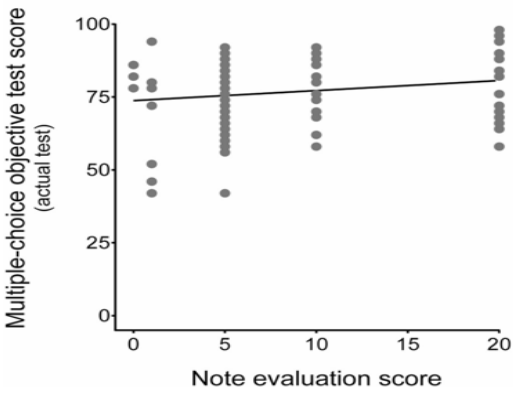
Findings

Association between lecture note assessments and multiple-choice examinations

Scatter plots were constructed to explore the connection between note assessment scores and multiple-choice exam results for both the practice exam **(Figure 1a)** and the formal exam **(Figure 1b)**. In each case, a positive correlation was observed between note quality scores and exam performance. Regression modeling revealed a linear relationship for the practice exam: $Y = 0.8628X + 66.99$, with $R^2 = 0.1126$, while the formal exam yielded $Y = 0.3440X + 73.76$, with $R^2 = 0.03457$.



a)



b)

Figure 1. Association between note assessment scores and multiple-choice exam performance

The X-axis represents the note evaluation scores (allocated as 0, 1, 5, 10, or 20 points). The Y-axis displays the scores obtained in the multiple-choice objective exams for the practice test (Panel A) and the formal test (Panel B). Each panel includes the corresponding regression line.

Association between lecture note assessments and essay examinations

In the essay examinations, students were permitted to refer to their notebooks and use their lecture notes during the practice test, but this was prohibited during the formal test. Consequently, the mean scores were lower in the formal test, where note usage was not allowed **(Table 3)**. Scores from both the practice and formal essay tests were plotted, and correlation analysis was conducted **(Figure 2a)**. The analysis revealed a linear relationship described by the equation $Y = 0.3301X + 21.25$, with a Pearson correlation coefficient of $r = 0.2486$.

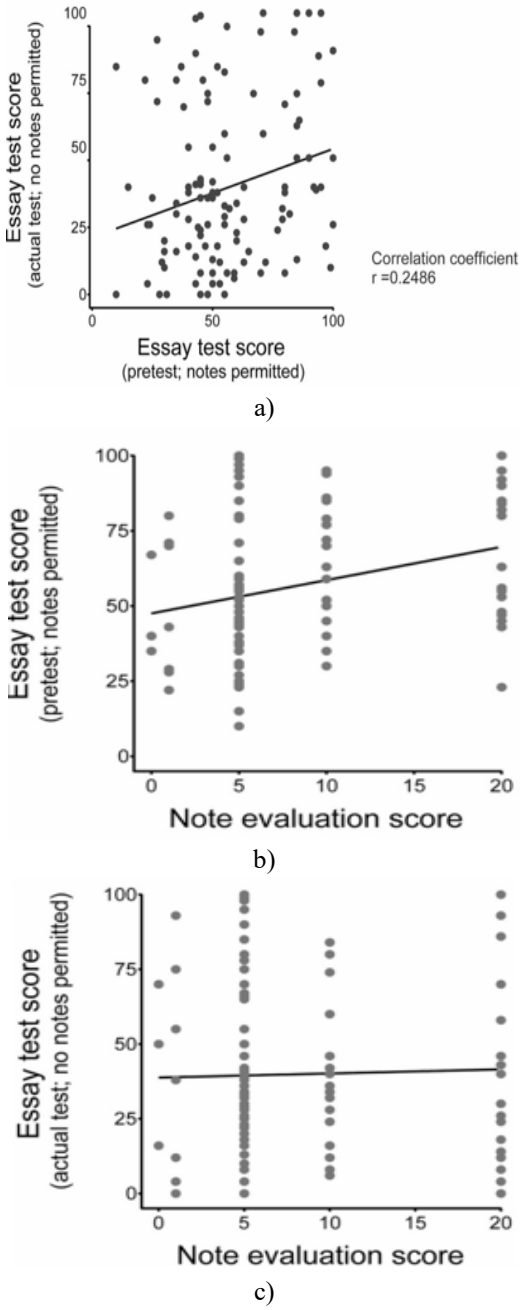


Figure 2. Association between note assessment scores and essay exam performance

Panel a displays a scatter plot comparing essay exam scores from the practice test and the formal test, with the Pearson correlation coefficient (r) annotated on the graph. Panels B and C illustrate the relationship between note assessment scores and essay exam scores. The X-axis shows the note evaluation scores (allocated as 0, 1, 5, 10, or 20 points). The Y-axis represents the essay exam scores for the practice test (Panel b) and the formal test (Panel c). Regression lines are included in each of these panels.

To examine the connection between lecture note assessment scores and essay exam performance, scatter plots were generated separately for the practice test **(Figure 2b)** and the formal test **(Figure 2c)**. Regression analysis for the practice essay test scores versus note assessment scores yielded a linear equation: $Y = 1.106X + 47.53$, with a determination coefficient of $R^2 = 0.09120$. In comparison, the regression for the formal essay test scores versus note assessment scores produced $Y = 0.1373X + 38.79$, with $R^2 = 0.0007971$. These findings indicate that higher note assessment scores do not necessarily correspond to higher essay exam performance when note usage is prohibited.

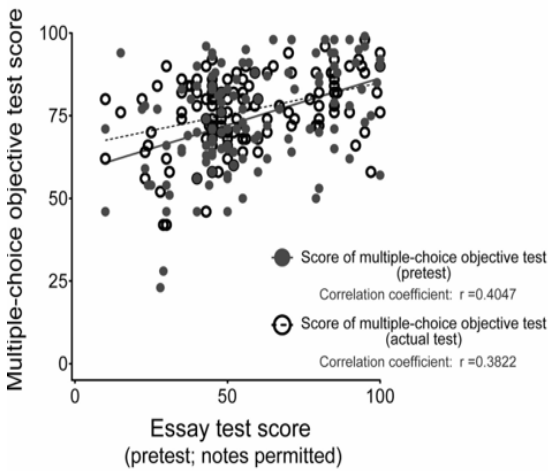
Association between multiple-choice objective exams and essay exams

Correlations were evaluated between multiple-choice objective exam results and essay exam outcomes (both with and without access to notes). Plots were created comparing the practice essay test (notes allowed) with both the practice and formal multiple-choice exams **(Figure 3a)**, as well as the formal essay test (notes prohibited) with both the practice and formal multiple-choice exams **(Figure 3b)**.

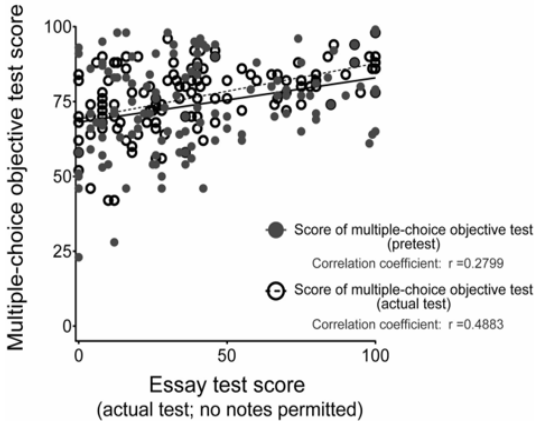
For the practice essay test (notes permitted) versus the practice multiple-choice exam, regression analysis showed $Y = 0.2840X + 57.95$ and $r = 0.4047$. The comparison between the practice essay test (notes permitted) and the formal multiple-choice exam yielded $Y = 0.1930X + 65.65$ and $r = 0.3822$ **(Figure 3a)**.

Regarding the formal essay test (notes prohibited), the analysis versus the practice multiple-choice exam produced $Y = 0.1480X + 68.10$ and $r = 0.2799$, while versus the formal multiple-choice exam it showed $Y = 0.1857X + 69.14$ and $r = 0.4883$ **(Figure 3b)**.

Overall, these data revealed positive correlations between multiple-choice objective exams and essay exams, irrespective of whether notes were permitted during the essay assessments.



a)



b)

Figure 3. Associations between Multiple-Choice Objective Exams and Essay Exams

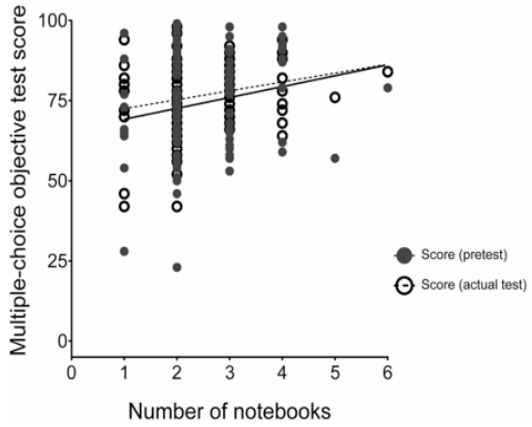
The X-axis displays the essay exam scores for the practice test (Panel a) and the formal test (Panel b). Students completed the essay exams either with access to their lecture notes (Panel a: practice test, notes allowed) or without (Panel b: formal test, notes prohibited). The Y-axis shows the multiple-choice objective exam scores. Filled symbols represent scores from the practice multiple-choice exam, while open symbols denote those from the formal multiple-choice exam. Pearson correlation coefficients (r) are annotated in each panel.

Association between the number of notebooks and exam performance

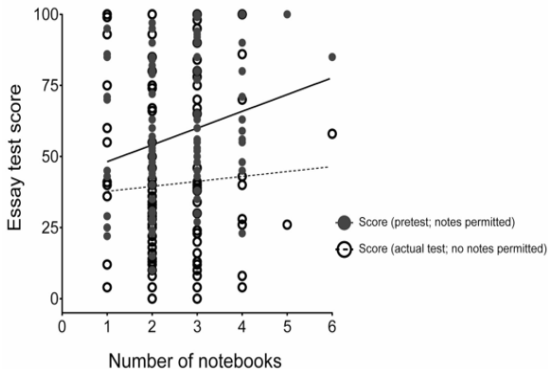
To determine whether the volume of notes influenced exam outcomes, the quantity of notebooks submitted by students was compared against scores in both multiple-choice objective exams and essay exams.

For the multiple-choice exams, the determination coefficients were $R^2 = 0.03696$ (practice test) and $R^2 = 0.04902$ (formal test), with regression equations of $Y = 3.390X + 65.81$ for the practice test and $Y = 2.763X + 69.76$ for the formal test. These results suggest only a weak association for both multiple-choice exams (practice and formal) **(Figure 4a)**.

In the essay exams, the determination coefficients were $R^2 = 0.05523$ (practice test) and $R^2 = 0.002762$ (formal test), with regression equations of $Y = 5.906X + 42.24$ for the practice test and $Y = 1.737X + 36.02$ for the formal test. Accordingly, a positive association was observed solely in the practice essay exam, where use of notebooks was permitted **(Figure 4b)**.



a)



b)

Figure 4. Association between the quantity of notebooks and exam outcomes

Panel a presents a scatter plot of multiple-choice objective exam scores versus the number of notebooks submitted. Panel b shows a scatter plot of essay exam scores versus the number of notebooks. The X-axis in both panels represents the number of notebooks, while the Y-axis indicates the corresponding exam scores.

Filled symbols correspond to scores from the practice test, and open symbols denote scores from the formal test in the essay panel. Regression lines are included in each panel.

This analysis of the associations between note evaluation scores and test outcomes indicated that the active utilization of lecture notes in dental pharmacology education was associated with higher performance on both multiple-choice objective tests and essay tests. Positive correlations were also found between scores on multiple-choice objective tests and essay tests. Notebook evaluations focused on comprehensive and effectively summarized content, specifically whether lecture and textbook material was concisely and efficiently organized. The study showed that students who produced higher-quality notes emphasizing essential points achieved better scores on multiple-choice objective tests. This pattern was consistent across both the first and second tests, pointing to a connection with enhanced performance in multiple-choice objective assessments. Given that the national examination relies entirely on multiple-choice objective questions, where logical reasoning is essential for selecting correct answers, the development and honing of logical thinking are tied to building practical skills that allow for appropriate handling of diverse challenges and problems. Mastering logical thinking is challenging through rote memorization alone or reliance on question booklets and practice exams. The note-taking practices promoted in this study are anticipated to foster logical thinking by requiring students to gather and condense lecture material in a clear and comprehensible manner [6].

In the multiple-choice objective tests, students who produced superior notes consistently outperformed those with lower-quality notes. The lecture notes for the first test functioned as a "memory aid" for knowledge retention, implying that the skills developed may differ from those involved in constructing logically structured written responses [9]. The multiple-choice test results demonstrated that students with stronger note-taking abilities performed better overall. This aligns with prior studies suggesting that notes primarily aid in recalling information but provide limited benefit for questions requiring inference [7, 8]. The act of note-taking, involving reflection on lecture content, may enhance memory retention, and academically stronger students might take more effective notes. However, this study did not account for inherent abilities or foundational academic skills independent of note-taking. Additional research is required to address these factors, such as by stratifying students using pre-lecture assessments or testing knowledge acquisition immediately after each session.

In the essay tests conducted twice, students were permitted to use their lecture notes during the pretest but not in the final test. Pretest essay results showed higher scores among students with superior notes who had systematically organized acquired knowledge. However, the final essay test revealed no association between note quality and performance. Earlier research has indicated that handwritten essay tests draw on both "semantic memory" from memorized content and "episodic memory" rooted in logical reasoning [10, 11]. This study did not anticipate that note-taking alone would substantially enhance episodic memory. Unexpectedly, the hypothesized outcomes were not observed. Access to lecture notes may have activated episodic memory, and repeated efforts to summarize content could have further strengthened it. This suggests that reflecting on lectures through note creation promotes logical thinking and improves episodic memory access. Although the level of effort invested in note-taking (e.g., time spent) was not assessed here, incorporating such measures could clarify the value of lecture notes in future investigations.

Positive correlations emerged between multiple-choice objective tests and essay tests (both pretest and final), irrespective of specific conditions. For multiple-choice objective tests and the pretest essay, note quality (superior vs. inferior, based on evaluation scores) positively correlated with outcomes, indicating that better note-taking skills were linked to higher grades. Superior notes were also viewed as reflecting greater "volume" of processed and reinforced course material from lectures and practicums. However, without adequate selective editing and summarization, much note-taking might simply involve transcribing content during class. Further exploration is needed to examine relationships between note quantity and academic performance. The study additionally suggested that lower-performing students may lack skills in refining notes and motivation to create and utilize them effectively. Future research should investigate whether teaching these students to produce concise, key-point-focused notes improves their scores. Active note use for memory consolidation is likely beneficial, and fostering habitual, skillful note-taking with strong summarization is expected to enhance overall academic performance.

Conclusion

The results of this study indicate that when students create notes that effectively summarize and clarify lecture content, this strengthens retention of learned material. Student efforts in note-taking appear to be a valuable study strategy for multiple-choice objective tests, including the national dental practitioner's examination. The findings also highlight that lecture notes support retention of knowledge-based memory. Moreover, consulting lecture notes may activate episodic memory grounded in logical thinking, as evidenced by performance in the essay test where notes were allowed. Combining essay tests permitting note use with multiple-choice objective tests prohibiting them could provide a comprehensive assessment of overall learning outcomes.

Acknowledgments: We are grateful to Professor Noriaki Katagi and Associate Professor Atsuhide Mori for many helpful discussions.

Conflict of Interest: None

Financial Support: None

Ethics Statement: None

References

1. Oberauer K, Meyer N. The contributions of encoding, retention, and recall to the Hebb effect. Memory. 2009;17(7):774–81. 10.1080/09658210903107861.
2. Larsen DP, London DA, Emke AR. Using reflection to influence practice: student perceptions of daily reflection in clinical education. Perspect Med Educ. 2016;5(5):285–91. 10.1007/s40037-016-0293-1.
3. Salame II, Tuba M, Nujhat M. Note-taking and its impact on learning, academic performance, and memory. Int J Instruction. 2024;17(3):599–616. 10.29333/iji.2024.17333a.
4. Bohay M, Blakely DP, Tamplin AK, Radvansky GA. Note taking, review, memory, and comprehension. Am J Psychol. 2011;124(1):63–73. 10.5406/amerjpsyc.124.1.0063.
5. Slotte V, Lonka K. Review and process effects of spontaneous note-taking on text comprehension. Contemp Educ Psychol. 1999;24(1):1–20. 10.1006/ceps.1998.0980.
6. Brazeau GA. Handouts in the classroom: is note taking a lost skill? Am J Pharm Educ. 2006;70(2):38. 10.5688/aj700238.
7. Kiewra KA, Benton SL, Lewis LB. Qualitative aspects of notetaking and their relationship with information-processing ability and academic achievement. J Instr Psychol. 1987;14(3):110–7.
8. Peverly ST, Sumowski JF. What variables predict quality of text notes and are text notes related to performance on different types of tests? Appl Cogn Psychol. 2011;26(1):104–17. 10.1002/acp.1802.
9. Miller GA, Galanter E, Pribram KH. Plans and the structure of behavior. New York: Holt; 1960. p. 32–6.
10. Yang BW, Razo J, Persky AM. Using testing as a learning tool. Am J Pharm Educ. 2019;83(9):7324. 10.5688/ajpe7324.
11. Herbert DMB, Burt JS. What do students remember? Episodic memory and the development of schematization. Appl Cogn Psychol. 2004;18(1):77–88. 10.1002/acp.947