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A Comparison of Learning Effectiveness Between Paper-Based and Tablet-Based Note-Taking

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Abstract

The objectives of this research article were to: 1) compare the effectiveness of note-taking using notebooks and research instruments—comprising document analysis forms and learning effectiveness questionnaires—between paper-based and tablet-based note-taking. Data were analyzed using frequency, standard deviation, and conclusion synthesis.

The research findings indicated that: 1) Regarding the frequency distribution of learning effectiveness between paper and tablet note-taking, the primary factor was the impact on learning speed and dimensions, followed by concentration and information perception, and academic achievement, memory, and recall. 2) A survey of 110 Ramkhamhaeng University students revealed: (1) Paper advantages: (1.1) brain/memory stimulation, (1.2) distraction-free focus, (1.3) tactile control, (1.4) eye comfort, (1.5) affordability. (2) Paper limitations: (2.1) portability, (2.2) editing difficulty, (2.3) writing fatigue. (3) Tablet advantages: (3.1) portability, (3.2) high storage, (3.3) editing flexibility, (3.4) aesthetic customization, (3.5) easy retrieval, (3.6) long-term cost reduction. (4) Tablet limitations: (4.1) digital distractions, (4.2) high cost, (4.3) eye fatigue, (4.4) battery dependency, (4.5) tactile issues, (4.6) reduced cognitive processing.

Keywords: Effectiveness, note-taking, learning

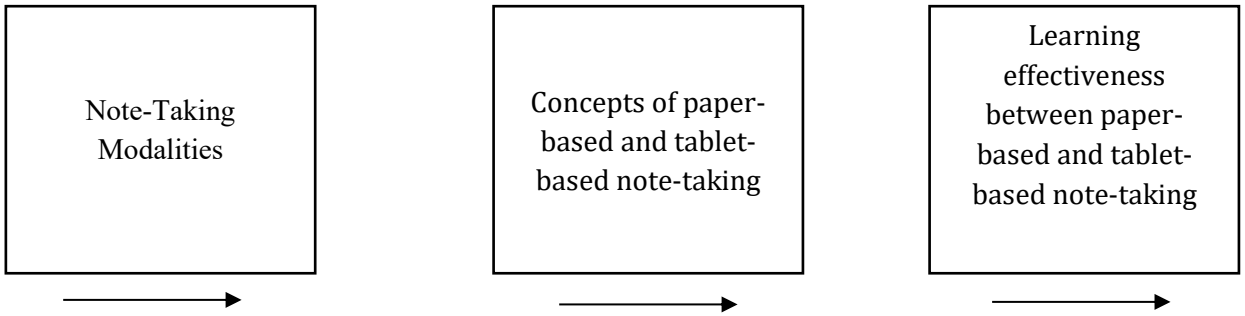
Introduction

In the digital era where technology plays a significant role in education, educational tools such as tablets have gained widespread popularity among students due to their convenience in data storage and document access. However, paper-based note-taking remains a popular and continuously utilized method. Indiana Aerospace University (2025) states that while learners appreciate technology-assisted tools for ease of searching and file organization, they return to 'handwritten notes' when precise memory and deep cognitive processing are required. The transition in note-taking formats from paper to tablets thus raises questions regarding the impact on learners' learning efficiency.

Note-taking is considered a vital learning process that enhances comprehension, retention, and content review. Keita Umejima (2021) conducted an experiment where participants recorded information and schedules in paper notebooks, tablets, and smartphones. Subsequently, functional magnetic resonance imaging (fMRI) was used to observe brain activity during memory retrieval—the process of recalling information or experiences stored in long-term memory. One hour later, the study found that the paper-based group exhibited significantly higher brain activity related to memory, as well as areas responsible for language and visualization. Consequently, the format of note-taking may influence learning levels and academic achievement, where paper-based note-taking may facilitate deeper cognitive processing, while tablet-based note-taking offers advantages in terms of speed, organization, and immediate editability.

While the aforementioned research found that paper-based note-taking promotes learning and memory better, in today's era where technology plays a significant role in daily life, using digital devices may be another alternative to increase convenience and learning efficiency. However, neglecting appropriate note-taking formats may cause learners to miss opportunities to develop thinking and learning processes that occur through manual note-taking. Consequently, the researcher is interested in studying the learning effectiveness between paper-based and tablet-based note-taking to compare academic achievement and memory retention efficiency from both methods. The research findings will be beneficial for learners, instructors, and educational institutions in selecting or promoting appropriate note-taking formats, which will lead to the development of learning efficiency consistent with the educational context in the digital age.

Conceptual Framework



Research Methodology

The methodology of this research is outlined below:

1) Research Procedures

1.1) Conducted a study of documents, textbooks, journals, and research regarding the concepts of learning effectiveness between paper-based and tablet-based note-taking.

1.2) Analyzed documents and research regarding learning effectiveness between paper-based and tablet-based note-taking using frequency analysis.

1.3) Summarized and presented frequency distribution tables of leaning effectiveness between paper-based and tablet-based note-taking.

1.4) Collected data from 110 Ramkhamhaeng University students through the following steps:

1.4.1) Developed the questionnaire based on the document and research analysis

1.4.2) Collected data using the questionnaire.

1.4.3) Summarized learning effectiveness using frequency distribution and content analysis.

2) **Research Sample**

110 Ramkhamhaeng University students.

3) **Research Instruments**

3.1) Document analysis form for learning effectiveness between paper-based and tablet-based note-taking.

3.2) Questionnaire regarding learning effectiveness between paper-based and tablet-based note-taking.

Research Results

Analysis of Learning Effectiveness Between Paper-Based and Tablet-Based Note-Taking.

The analysis results of learning effectiveness between paper-based and tablet-based note-taking are presented in Table 1.

Table 1

Frequency Distribution of Learning Effectiveness Between Paper-Based and Tablet-Based Note-Taking

No.	Learning Effectiveness	The Pen Is Mightier Than the Keyboard: Advantages of Longhand Over Laptop Note Taking (2557)	Apple classroom: managing tertiary English classes with iPads (2564)	A Comparative Study of Learning Achievement between E-Books and Traditional Methods in History Subject of Grade 8 Students (2567)	Introducing The iPad in A Norwegian High School: How Do Students and Teachers React to This Technology (2554)	Paper Notebooks vs. Mobile Devices: Brain Activation Differences During Memory Retrieval (2564)	Only Three Fingers Write, but the Whole Brain Works†: A High-Density EEG Study Showing Advantages of Drawing Over Typing for Learning (2560)	iPad と紙、結局手書きはどっちがおすすめ？ (2569)	紙のノートの脳科学的効用 (2564)	ノートはタブレットよりテスト得点が 2 割増！立命館大学と「ノートとタブレットへの筆記における記憶効果の比較」の共同研究を実 (2566)	The effect of the Cornell method on the quality of grade production and learning performance of nursing students (2566)	Frequency
1	Concentration and Information Perception	✓	✓			✓	✓		✓		✓	6
2	Retention and Memory	✓				✓			✓		✓	4
3	Processing Speed and Learning Dimensions	✓	✓	✓	✓	✓	✓	✓	✓		✓	9
4	Focus and Attention				✓					✓	✓	3
5	Academic Achievement and Performance		✓	✓						✓	✓	4
6	Satisfaction and Limitations		✓		✓			✓				3

Based on Table 1, the frequency analysis of learning studies between paper-based and tablet-based note-taking from various references can be summarized in a synthesis table. It reveals that note-taking between paper and tablets primarily impacts learning speed and dimensions (f=9), followed by concentration and information perception (f=6), academic achievement, memory, and recall (f=4), and concentration and focus (f=3), respectively.

Survey Results on Learning Effectiveness Between Paper-Based and Tablet-Based Note-Taking Among Ramkhamhaeng University Students.

The survey results regarding the note-taking behaviors of 110 Ramkhamhaeng University students are presented as follows:

1) Note-taking behaviors of Ramkhamhaeng University students: (1) Paper/notebook only, accounting for 34.5%; (2) Concurrent use (Tablet 70% : Paper 30%), accounting for 29.1%; (3) Concurrent use (Paper 70% : Tablet 30%), accounting for 22.7%; and (4) Tablet only, accounting for 13.6%

2) Primary note-taking formats of Ramkhamhaeng University students: (1) writing summaries based on self-understanding, accounting for 76.4%; (2) note-taking on lecture slides/instructional materials, accounting for 56.4%; (3) verbatim note-taking (Dictation), accounting for 27.3%; and (4) focusing on drawing/diagramming (Mind Maps), accounting for 15.5%. Survey results from 110 Ramkhamhaeng University students regarding the learning effectiveness between paper-based and tablet-based note-taking.

3) From the frequency analysis table of the study on learning between paper-based and tablet-based note-taking regarding concentration and information perception, it can be concluded through the analysis table that: (1) most Ramkhamhaeng University students can take notes while simultaneously thinking and understanding the instructor’s lecture smoothly at a moderate level (f=38); (2) most Ramkhamhaeng University students feel the need to rush their writing to keep up with the instructor’s speech to the point of having no time for critical analysis of the content at a moderate level (f=29); and (3) the format and scope of the equipment used (Paper/Tablet) helps organize cognitive systems effectively for Ramkhamhaeng University students at a high to highest level (f=33). Details are shown in Table 2.

Table 2

Survey Results on the Learning Effectiveness Between Paper-Based and Tablet-Based Note-Taking Regarding Concentration and Information Perception (n=110)

Section 1: Concentration and Information Perception	**Frequency**				
	Lowest	Low	Moderate	High	Highest
I can take notes while simultaneously following and comprehending the instructor's lecture smoothly.	4	19	38	28	21
I feel the need to record the instructor's speech promptly to keep pace, leaving insufficient time for critical content analysis.	14	31	29	22	14
The format and scope of the tools utilized (paper/tablet) facilitate effective cognitive organization.	3	12	29	33	33

4) From the frequency analysis table of learning studies between paper-based and tablet-based note-taking regarding memory and recall, it can be concluded through the analysis table that: (1) most Ramkhamhaeng University students opine that paper-based note-taking enhances classroom content retention at moderate and highest levels (f=38); (2) most Ramkhamhaeng University students opine that tablet-based note-taking enhances classroom content retention at a moderate level (f=52); (3) most Ramkhamhaeng University students find that reviewing from paper leads to faster comprehension at a moderate level (f=42); and (4) most Ramkhamhaeng University students find that reviewing from a tablet leads to faster comprehension at a moderate level (f=52). Details are shown in Table 3

Table 3

Results of the Learning Effectiveness Survey Between Paper-Based and Tablet-Based Note-Taking Regarding Memory and Recall (n=110)

Section 2: Retention and Memory	**Frequency**				
	Lowest	Low	Moderate	High	Highest
Paper-based note-taking enhances classroom content retention more effectively.	0	11	38	23	38
Tablet-based note-taking enhances classroom content retention more effectively.	7	22	52	21	8
Upon review, reading from paper results in faster content comprehension.	0	10	42	26	32
Upon review, reading from a tablet results in faster content comprehension.	4	20	52	19	15

5) From the frequency analysis table of the study on learning between paper-based and tablet-based note-taking regarding learning speed and dimensions, it can be concluded through the analysis table that: (1) most Ramkhamhaeng University students opine that paper-based note-taking allows for more freedom in summarizing and linking ideas at the highest level (f=38); (2) most Ramkhamhaeng University students opine that tablet-based note-taking saves time in organizing content at the highest level (f=41); and (3) most Ramkhamhaeng University students opine that the device's surface texture is an obstacle to their note-taking speed at the highest level (f=31). Details are shown in Table 4

Table 4

Results of the Learning Effectiveness Survey Between Paper-Based and Tablet-Based Note-Taking Regarding Learning Speed and Dimensions (n=110)

Section 3: Processing Speed and Learning Dimensions	**Frequency**				
	Lowest	Low	Moderate	High	Highest
Paper-based note-taking allows for greater freedom in summarizing and linking ideas.	1	12	32	23	38
Tablet-based note-taking saves time in organizing content. (e.g., inserting images, highlighting)	4	10	22	33	41
The device's tactile surface (paper roughness/glass smoothness) is an obstacle to my note-taking speed.	14	16	29	20	31

6) From the frequency analysis table of the study on learning between paper-based and tablet-based note-taking regarding concentration and focus, it can be concluded through the analysis table that: (1) most Ramkhamhaeng University students find that paper-based note-taking fosters concentration and minimizes distractions during class at the highest level (f=40); (2) most Ramkhamhaeng University students opine that tablet-based note-taking involves stimuli that cause loss of concentration at a moderate level (f=37). Details are shown in Table 5

Table 5

Results of the Learning Effectiveness Survey Between Paper-Based and Tablet-Based Note-Taking Regarding Concentration and Focus (n=110)

Section 4: Focus and Attention	**Frequency**				
	Lowest	Low	Moderate	High	Highest
Paper-based note-taking fosters concentration and minimizes distractions during class.	3	5	27	35	40
Tablet-based note-taking involves stimuli (e.g., notifications, social media, games) that cause a loss of concentration.	2	9	37	27	32

7) From the frequency analysis table of the study on learning between paper-based and tablet-based note-taking regarding academic achievement, it can be concluded through the analysis table that: (1) most Ramkhamhaeng University students feel that subjects note-taken on paper result in better examination scores at a high level (f=37); and (2) most Ramkhamhaeng University students feel that subjects note-taken on a tablet result in better examination scores at a moderate level (f=46). Details are shown in Table 6

Table 6

Results of the Learning Effectiveness Survey Between Paper-Based and Tablet-Based Note-Taking Regarding Academic Achievement (n=110)

Section 5: Academic Achievement and Performance	**Frequency**				
	Lowest	Low	Moderate	High	Highest
You perceive that subjects recorded via paper-based note-taking lead to improved examination scores.	7	6	33	37	27
You perceive that subjects recorded via tablet-based note-taking lead to improved examination scores.	9	15	46	25	15

8) From the frequency analysis table of the study on learning between paper-based and tablet-based note-taking regarding satisfaction and limitations, it can be concluded through the analysis table that: (1) most Ramkhamhaeng University students opine that paper provides convenience in portability and long-term document storage at a moderate level (f=40); (2) most Ramkhamhaeng University students opine that tablets provide convenience in portability and long-term document storage at the highest level (f=48); (3) most Ramkhamhaeng University students opine that paper is cost-effective at a moderate level (f=47); (4) most Ramkhamhaeng University students opine that tablets are cost-effective at a high level (f=37); and (5) health impacts are at the highest level (f=38)

Results of the survey regarding the advantages and limitations of paper-based and tablet-based note-taking among 110 Ramkhamhaeng University students, as detailed in Table 7

Table 7

Results of the Learning Effectiveness Survey Between Paper-Based and Tablet-Based Note-Taking Regarding Satisfaction and Limitations (n=110)

Section 6: Satisfaction and Limitations	**Frequency**				
	Lowest	Low	Moderate	High	Highest
Portability convenience and long-term document storage. (Paper)	10	20	40	22	18
Portability convenience and long-term document storage. (Tablet)	2	6	23	31	48
Cost-effectiveness relative to expenditure. (Paper)	3	9	47	27	24
Cost-effectiveness relative to expenditure. (Tablet)	2	5	31	37	35
Health impacts. (e.g., ocular strain from screens or hand pain from writing)	3	3	34	32	38

9) The advantages of paper-based note-taking are as follows: (1) Learning efficiency and retention: stimulating the brain and enhancing memory, as handwriting facilitates cognitive processes, analysis, and data synthesis based on personal understanding, leading to precise recall, holistic perspectives, faster information retrieval, and simultaneous lesson review while writing; (2) Concentration and focus: absence of distractions and notifications from various applications that divert attention like tablets or mobile phones, fostering mindfulness and awareness during the recording process; (3) Tactile sensation and emotion: providing a realistic and tangible feeling, where paper roughness aids in controlling hand pressure and handwriting, making writing enjoyable; (4) Eye preservation: eliminating the need for prolonged screen exposure, thereby reducing ocular strain, irritation, or fatigue; and (5) Economy and accessibility: inexpensive equipment that is easily purchased, without concerns regarding battery depletion or internet connectivity.

10) The limitations of paper-based note-taking are as follows: (1) Inconvenient portability and weight: studying multiple subjects requires carrying numerous notebooks or documents, increasing bag weight; when recorded across multiple sheets or volumes, searching for retrospective data or specific topics is slow and cumbersome; risk of loss and damage, with information being permanently lost (no backup); (2) Difficult and untidy editing: corrections require tools, resulting in time consumption, erasure marks, and disorderliness; when a page is full, it is impossible to expand space, copy, or insert additional text/images later, unlike digital systems; and (3) Physical strain and long-term costs: prolonged handwriting causes hand and finger fatigue; enjoyable note-taking necessitates smooth, high-quality pens; decorating lectures requires multiple colored pens, leading to high long-term expenditures; notebooks or paper must be constantly repurchased, including hidden costs such as photocopying.

11) The advantages of tablet-based note-taking are as follows: (1) A single device can replace multiple notebooks, reducing space and bag weight; (2) Large volumes of notes, documents, slides, and files can be stored, allowing for systematic categorization and efficient content searching; (3) Real-time deletion, editing, relocation of text, and insertion of images are possible, supported by assistive functions such as undo, highlighting, and pen color customization; (4) Notes are aesthetically organized, legible, and adaptable to user preferences; (5) Information retrieval and review are simplified through seamless connectivity with applications, educational tools, and artificial intelligence; and (6) Long-term expenditures on notebooks and writing materials are minimized, promoting resource conservation.

(12) The limitations of tablet-based note-taking are as follows: (1) Notifications from applications or social media may cause distractions during learning; (2) The high cost of tablets and accessories, such as styluses, and potential additional expenses for certain note-taking applications; (3) Prolonged screen exposure may lead to eye strain, fatigue, or ocular discomfort; (4) Battery depletion renders the device unusable, while hardware failure or loss can impede data accessibility; (5) The screen's surface texture differs from paper, which may result in a less ergonomic writing experience for some individuals; and (6) Excessive reliance on assistive functions may reduce manual cognitive processing of the content.

Conclusion

Based on the analysis table of learning effectiveness between paper-based and tablet-based note-taking via survey methodology, it was found that Ramkhamhaeng University students consist of groups using exclusively paper, exclusively tablets, and a combination of both media according to personal preference. Regarding primary note-taking formats, the most prevalent method is summarizing content based on individual understanding, followed by annotating course materials, verbatim transcription of lectures, and constructing mind maps for content integration.

A comparative analysis of the effectiveness of paper-based versus tablet-based note-taking reveals that both media impact learning dimensions distinctly. Paper-based note-taking is particularly notable for enhancing concentration and focus, as it is devoid of external stimuli and distracting notifications. This facilitates autonomous critical thinking and information filtering, leading to more precise memory retention and superior recall; indeed, most students reported higher academic achievement and test scores in subjects where paper was used. In contrast, tablet-based note-taking is distinguished by its efficiency in content organization and accessibility for review. However, it often encounters obstacles such as application-based distractions that may disrupt learning, along with an over-reliance on assistive features that may attenuate manual cognitive processing.

Regarding satisfaction and operational constraints, paper provides freedom in conceptual association, a tactile surface for better handwriting pressure control, ocular comfort, and high affordability. However, it faces limitations in portability for large document volumes, difficulty in retrospective searching, and risks of permanent damage or loss. Conversely, tablets offer portability, systematic storage and retrieval, and rapid editing capabilities, being perceived as cost-effective in the long term. Nonetheless, tablets present significant limitations concerning ocular health, battery dependency, high initial costs, and screen surface textures that may impede writing speed.

In conclusion, both note-taking media play distinct roles in enhancing learning effectiveness across different dimensions. Paper is highly suitable for learning that requires deep concentration, critical analysis, and content retention. In contrast, tablets serve as tools that cater to learning characterized by mobility, systematic management of large information volumes, and convenience. Therefore, maximizing the benefits of these devices depends primarily on individual preference, course context, and the learning styles of each student.

Discussion of Research Findings

The findings of this study revealed the following key points:

1) The analysis of note-taking behaviors and patterns among Ramkhamhaeng University students revealed that the majority still prefer exclusively using paper/notebooks (34.5%). This is followed by hybrid use primarily on tablets (70% Tablet : 30% Paper) at 29.1%, hybrid use primarily on paper (70% Paper : 30% Tablet) at 22.7%, and exclusively using tablets at the lowest frequency of 13.6%. Regarding primary note-taking formats, summarizing based on personal understanding ranked first, followed by annotating instructional slides or materials, verbatim transcription, and mind mapping. This indicates that despite the digital era, most students still prioritize paper-based note-taking as their primary method.

2) The analysis of concentration and information perception effectiveness revealed that most students were able to simultaneously take notes and comprehend the lecture at a moderate level. Similarly, the feeling of needing to transcribe the lecture verbatim, leaving insufficient time for critical analysis, was also at a moderate level. However, students perceived that the format and scope of the devices used significantly helped organize their thoughts, ranging from a high to very high level. This aligns with the concentration and focus analysis, which indicated that paper-based note-taking facilitated maximum concentration without distraction, while tablet-based note-taking involved moderate levels of distraction from external stimuli. This corresponds with the identified advantages and limitations: paper provides a distraction-free environment without application notifications, unlike tablets, thereby enhancing the learner's cognitive processing, analysis, and focus on the lesson.

3) The analysis of memory and recall effectiveness indicated that most students perceived paper-based note-taking as facilitating superior content retention at moderate to maximum levels. During review, reading from paper enabled faster comprehension at a moderate level. Van der Meer, A.L.H., & Van der Weel, F.R. (2024) state that neuroscientific research shows handwriting activates brain connectivity associated with learning and memory. This aligns with findings that paper provides maximum freedom for conceptual association. Handwriting stimulates the brain, leading to an enhanced overview and more rapid recall. Conversely, tablets showed moderate effectiveness in retention and comprehension. While tablets maximized efficiency in organization and retrieval, the screen's surface texture significantly impeded writing speed at the maximum level.

4) The analysis of academic achievement, satisfaction, and limitations revealed that the majority of students perceived that subjects using paper-based note-taking resulted in higher exam scores at a high level, whereas tablet-based subjects resulted in higher exam scores at a moderate level. Regarding long-term satisfaction and constraints, tablets were recognized for their portability and long-term storage convenience at the maximum level. In contrast, paper was perceived as difficult to carry, heavy, and susceptible to damage or loss at a moderate level. In terms of cost-effectiveness, paper was considered moderate, while tablets were highly cost-effective; despite high initial costs for devices and applications, they are more economical than expenses for paper, notebooks, and writing utensils (e.g., pens, highlighters, pencils) in the long term. However, a critical concern is the health impact of device usage, which students rated at the maximum level. This aligns with the limitations of tablets, including eye strain and ocular pain from prolonged screen exposure, as well as digital pen-induced finger fatigue over extended periods.

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