# EXPLORING OPTIMAL NOTE-TAKING PRACTICES: A COMPARATIVE STUDY OF IN-PERSON AND ONLINE LEARNING ENVIRONMENTS

By

Rawan Wael Gabr

A capstone project submitted for Graduation with University Honors

May 10, 2024

University Honors
University of California, Riverside

APPROVED

Dr. Annie S. Ditta
Department of Psychology

Dr. Richard Cardullo, Howard H Hays Jr. Chair
University Honors

ABSTRACT

While many students take photos of lecture slides during class, research has revealed that doing so may impair memory for photographed content compared to unphotographed content. However, little is known about how taking both photos and notes simultaneously affects learning from a lecture. Early work on this topic from our lab has found a significant note-taking benefit but also a significant photo-taking impairment when students engage in these behaviors in an in-person class setting. The present study sought to replicate these findings in an online setting. In addition, the present study sought to evaluate the relationship between quality of the notes and learning from the lecture. Specifically, we: 1) compared the difference in the number of correct answers found in the notes when taking both photos and notes compared to only taking notes, and 2) correlated the proportion of answers found in the notes with memory performance. Additionally, we used a cross-experiment comparison to examine these effects in in-person vs. online settings. The findings indicate that participants had better note quality when they only took notes compared to when they took photos and notes together; however, this difference only emerged in-person. In both in-person and online environments, note quality was significantly related to memory performance such that having more answers in the notes was related to higher test scores on the lecture content. Together, our results suggest that the nature of the relationship between photo- and note-taking and learning may differ across instructional modality.

ACKNOWLEDGEMENTS

There were many guiding hands that contributed indispensably to the fruition of this project, and I owe each a heartfelt thank you for their support and mentorship. First and foremost, I extend my deepest gratitude to my Faculty Mentor Dr. Annie S. Ditta. Without her mentorship, this project would not have been possible. Her unwavering support and exceptional guidance have been crucial in navigating this research. Thank you for believing in me and in the potential of this project. It was the cornerstone of our success.

Professor, You were the first to teach me, and it has been a profoundly moving honor to conclude my journey at UCR under your mentorship.

I am also immensely thankful to Ph.D. candidate Maribeth Trego, who not only allowed me the privilege of contributing to her innovative work but supported me at every turn. Her insights and encouragement have been nothing short of exemplory.

A special thank you goes to my family, who have been my steadfast supporters despite the physical distance between us. Your belief in me has been a constant source of strength, and I am eternally grateful for your love and encouragement. You have always been there to lift me up during challenging times, and without you, I would not be where I am today.

I am equally grateful for the friends I am able to call family. Thank you for standing by me, for all the late-night discussions, and for all the times you pushed me to strive for excellence.

Long before the digital age, the classic method of pen-and-paper note-taking was a simple yet effective way to record information, used by more than 75% of college freshmen (Santa et al., 1979). Many variations of notetaking were thus born, especially in the 80s and 90s. Some of these note-taking strategies included the Cornell method created in the 1950s by Walter Pauk (The Cornell Method for Note-Taking, n.d), the Outlining method coined between 1984 and 1995 by educational psychologist Kenneth A. Kiewra (Tamm, 2021), and the Mapping method which was popularized in the 1970s by Tony Buzan (Opinaldo, 2022). Many of these methods employ systems that enable students to fully utilize their notes by actively engaging with the material, rather than merely transcribing them passively. For example, the Cornell method instructs students to divide their notebook paper into three distinct sections: one for class notes, another for questions and keywords found in the notes, and a final summary section to capture the main points on each page (Jansen et al., 2017). The Outlining method involves listening to the lecture and writing down notes in bullet points using an organized space indentation system (Tamm, 2021). Finally, for those interested in a visual approach to note-taking, the Mapping method offers a structured way to visually represent the progression of ideas. Central to this technique is placing the main idea in the middle of the page, from which students can branch out with supplementary information (Dagher, 2022). This method is highly regarded for its ability to help people brainstorm and create meaningful connections with information (Opinaldo, 2022).

But even by setting aside the nuances of different note-taking strategies, it's clear that the act of note-taking itself is crucial for academic success. Blankenship (2016) showcased this by demonstrating note-taking's significant impact on enhancing test performance, irrespective of the method used, compared to not taking notes at all. Building on this foundational research,

additional work has continued to explore the unique benefits of note-taking. One notable study by Haynes et al. (2015) found that taking notes during lectures not only allows students to record more relevant information but also improves their retention of the material, which leads to higher quiz scores. One study even found that note-taking serves dual functions: it acts as an encoding mechanism, helping students to process and internalize information, and as an external storage system, preserving details for later recall. These processes are crucial for reconstructing knowledge and significantly enhance recall (Rickards & Friedman, 1978).

Change however is inherent in all things, and note-taking is no exception. In our current era, a student aiming to take notes during a lecture no longer needs to worry about packing a pencil and notebook. Instead, by simply possessing a smart device such as a laptop, smartphone, or tablet, they gain access to a wealth of new note-taking strategies such as typing, taking photos of lecture slides or even utilizing a tablet to take electronic notes. Consequently, the concept of note-taking is taking a new shape and continues to evolve with students increasingly embracing digital tools to enhance their note-taking practices (Stacy & Cain, 2015). The use of digital note-taking tools such as laptops, smartphones, and tablets can be particularly beneficial for students who face challenges with traditional pen-and-paper note-taking methods, as handwriting can be time-consuming and may cause them to miss important information during lectures. Studies have shown that faster writers tend to produce higher-quality notes, which aids in information retention and exam performance, due to their ability to capture more notes (Manzi et al., 2017).

Salem (2020), however, found that different note-taking methods–including both traditional and digital methods–have comparable effects on student performance, with no single method proving more effective than others. Indeed, this study revealed significant gains in understanding across all groups that underwent conventional (taken using paper and pen based

on the note-taker judgment of important content), structured (notes following a specific format), and 'camera-captured' (taking photos of the board with a digital device) note-taking conditions, further indicating that any method of note-taking can enhance students' conceptual understanding more than not taking notes at all. This underscores the importance of note-taking regardless of the methods employed to do so.

In this regard, digital note-taking tools like laptops to type notes can potentially help these students keep up with the pace of lectures. Another new note-taking strategy is taking pictures of lecture slides with a smartphone camera. According to a study done at the University College of Education (DUCE) in Tanzania, taking photos as a form of note-taking was popular among students–credited for its speed, easy access, and accuracy (Mfaume et al., 2018). But however convenient this particular method may be, does it ensure that students comprehend, understand, and engage with the material as effectively as they would when taking handwritten notes themselves? In this particular study, the answer was no. Researchers found through survey results, that 54% of students reported the act of taking photos during lectures as distracting which hindered their ability to concentrate and retain lecture information. Additionally, students reported impaired handwriting skills and speed as a result of relying on taking photos as a form of note-taking. There was also a notable negative impact of taking photos on students' attendance at lecture sessions, suggesting that the practice might discourage regular participation. This phenomenon was attributed to students' reliance on accessing lecture notes through established WhatsApp groups, which diminished the perceived importance of attending lectures in person. And finally as reported by the researchers, taking photos distorted students' ability to effectively compose and organize their academic work and increased the incidence of plagiarism, hindering their overall learning process and academic success (Mfaume et al., 2018).

Additional negative effects of photo-taking have been documented both in and out of the classroom. As noted in the study by Wong and Lim (2021), photo-taking is less effective than traditional handwritten note-taking. Longhand note-taking was said to require more active engagement which reduces mind-wandering during the lecture and promotes better information retention, ultimately leading to improved learning outcomes. Similarly, research exploring the photo-taking impairment effect (though not in a classroom setting) found that taking multiple photos can lead to decreased memory retention compared to not taking photos at all (Soares & Storm, 2022). In the realm of note-taking, students are more than likely to take photos of multiple slides, which means this phenomenon can directly affect the retention of the content captured in these pictures.

However, some literature suggests a photo-taking benefit. According to Ditta et al. (2022) photographing lecture slides enhanced memory for the content related to the photographed slides compared to slides that were not photographed. Importantly, this study was conducted online, whereas the studies that found photo-taking impairments were conducted in-person, so perhaps there are differences in the photo-taking effect depending on class modality (i.e., in-person vs. online classes).

Due to these conflicting findings regarding the effect of photo-taking on learning, we sought to explore two critical questions. First, could the modality of instruction, such as online versus in-person classroom settings, play a role in determining the efficacy of note-taking techniques and learning from the material? Second, what is the effect of combining traditional pen-and-paper note-taking with photo-taking on note-taking quality, a multi tasking behavior that appears to be increasingly prevalent in college classrooms today?

The current study aims to build upon the findings from two prior experiments conducted

in our lab that investigated the impact of photo- and note-taking strategies on memory retention in both in-person and online learning contexts. Both experiments compared learning across four conditions: taking photos only, taking handwritten notes only, combining photos and handwritten notes, and simply watching the lecture without any note-taking. The results revealed a significant advantage for handwritten note-taking in enhancing memory retention, whereas relying solely on photographs resulted in a detrimental effect on memory performance compared to not taking photos. The second experiment replicated the first study in an online setting, though there was no significant photo-taking impairment in the online environment.

Importantly for the current work, both experiments also collected data on the relationship between the quality of participants' handwritten notes and memory performance. This capstone project seeks to examine the interplay between note quality, classroom environment, and memory retention in several ways. First, by investigating the difference in note quality (defined as the number of answers from the test appearing in the notes) between conditions where participants took notes alone (Note Only) and conditions where they combined note-taking with photo-taking (Photo+Note). Second, by investigating the relationship between the quality of notes and memory performance when taking notes alone and when taking both photos and notes. Finally, we present our results from the in-person and online versions of the study to provide a cross-experiment examination of modality (in-person vs. online). We hypothesized that the Note Only condition irrespective of learning modality (In-person vs Online) would yield better note quality compared to taking both photos and notes. We hypothesized this because there would be more multitasking involved in taking both photos and notes compared to notes alone, which would reduce the amount of attention participants have to allocate to learning the material. Additionally, we also hypothesized that better quality note-taking would correlate with improved

test performance across all note-taking conditions and modality. However, this relationship might vary in strength depending on the specific conditions, which we explored more tentatively. We did not have specific predictions about which conditions would have stronger or weaker relationships.

With this work, we aim to shed light on the factors related to note-taking effectiveness and provide insights into how students can optimize their note-taking strategies in the face of evolving educational landscapes and technological integration. The present work will help bridge the gaps in our understanding and further inform us about the conditions under which these methods can be most effective.

## Method

### Participants

The total number of participants across both studies was 485, with 237 participating in the in-person version and 248 in the online version. After excluding 21 participants due to non-compliance with the study protocols (e.g., not taking photos when required or not taking handwritten notes when instructed), the final sample size for the in-person setting was N = 216. Similarly, for the online condition, 90 participants were excluded due to using notes or photos on the online test, resulting in a final sample size of N = 158. This higher number of participants excluded from the online study is to be expected, given that participants were not able to be monitored as closely for adherence to study instructions as the in-person participants. Their noncompliance was caught with compliance questions asked at the end of the study. All participants were undergraduate students from the University of California- Riverside (UCR) recruited through the UCR SONA system and received partial course credit for their participation.

## Design

The procedure for both the in-person and online versions of the study followed a fully within-subjects factorial design with two factors: Photo-taking (photo vs. no photo) and Note-taking (notes vs. no notes). To create these conditions, we utilized two lectures that each had a different set of instructions regarding how to engage with the material on certain slides. In one lecture, participants were instructed to take photos for a randomly-determined half of the slides, while refraining from taking photos for the remaining slides. This created the photo-taking and control conditions. In the second lecture, participants were asked to take handwritten notes throughout the lecture and were asked to take photos of a randomly determined half of the slides. This setup established the note-taking and photo+note-taking conditions. Consequently, across the two lectures, four distinct conditions were created: photo-taking, control (no photo-taking), note-taking, and photo+note-taking. These conditions were counterbalanced across participants.

## Materials & Measures

### *Lecture videos*

The lecture videos were adapted from prior work on photo-taking in education (Ditta et al., 2022). The topics chosen for the lecture videos were cheesemaking and printmaking. They were specifically selected because they are likely unfamiliar to undergraduate psychology students. These lectures consisted of approximately 10 slides each, with bulleted information on all slides, and corresponding images on some of the slides, as in a typical classroom lecture.

A camera icon was placed in the bottom left corner of half of the slides, selected at random, to indicate which slides participants should photograph. Conversely, the other half of the slides featured a different symbol signaling that pictures should not be taken. Each lecture video was structured as a PowerPoint presentation that had stationary slides with voiceover

lecture. The videos were both approximately 5 minutes in length, for a total lecture time of approximately 10 minutes The source material for each video's content was adapted from Wikipedia articles, and the narration accompanying the slides was read verbatim from the Wikipedia articles.

*Distraction Task*

A Flash-based game named “Bubble Shooter” was selected as the distractor and it was employed once for five minutes in between the lectures and the memory test. The purpose of this game was to serve as a visually demanding and engaging distractor task after watching the lecture videos.

*Final Memory Test*

Participants in the study took a short answer test consisting of 15 fill-in-the-blank questions on each of the two lectures (for a total of 30 questions), using test materials that were originally created by Ditta et al. (2022).

*Note Quality*

The participants’ notes from the note-taking conditions were collected and transcribed for analysis. Note quality was measured by counting the number of correct answers corresponding to the memory test found in the notes. Thus, the maximum note quality score they could earn was 15.

Procedure

The in-lab study required participants to come into the lab and complete the study on Qualtrics while being supervised by a research assistant. After participants provided their informed consent, they underwent the instruction phase. In the first lecture, participants were asked to take pictures of half the slides with their personal smartphone (set to airplane mode) and

just watch the other half quietly. In the second lecture, participants took handwritten notes for the duration lecture in a provided notebook and also took photos of half the slides as previously described. Condition order was counterbalanced across participants, but the order of the lecture topics was held constant (i.e., printmaking was always first and cheesemaking was always second). After they had watched both lectures, participants would complete the 5-minute Bubble Shooter delay, and then take the two short-answer tests to assess their memory on the lecture content. After finishing the study, participants were debriefed, awarded credit for their participation, and were thanked for their involvement. The online version of the study was identical, with the exception of completing the study without supervision on their home device.

## Results

### Data Analysis

Note quality, measured by the number of correct answers corresponding to the memory test found in the notes, was compared between the two note-taking conditions: Photo+Note and Note-Only. To evaluate the difference in note quality between these two conditions, we employed two paired-sample *t*-tests, with one analyzing the online data and the other analyzing the in-person data. Additionally, we examined the correlation between the number of answers in the notes for the Note-Only and Photo+Note conditions and the number of correct answers in the corresponding tests for both in-person and online settings. This gave us a total of four correlations. All analyses were run in Jamovi.

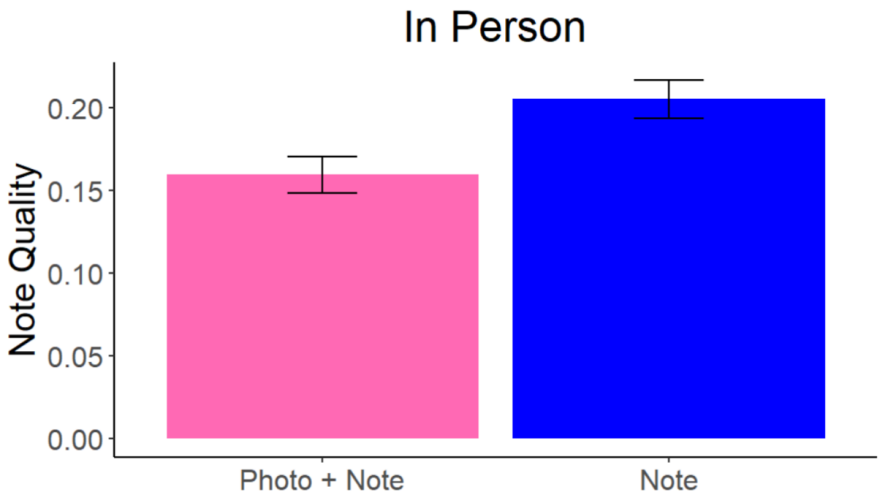
### Note Quality: In-person

A paired-sample *t*-test comparing note quality between the Note-Only and Photo+Note conditions revealed a significant difference in the quality of notes, $t(215) = 3.32$, $p < 0.001$. There was a higher proportion of answers contained in the notes for the Note-Only condition (*M*

= 0.21, *SD* = 0.17) compared to the Photo+Note condition (*M* = 0.16, *SD* = 0.16; see Figure 1). These findings suggest that participants were able to capture more answers in their notes when they focused solely on writing their notes, as opposed to dividing their attention between taking photos and writing.

**Figure 1**

*In-Person Note quality between Note-Only and Photo+Note conditions*




*Note.* A significant difference in note quality between conditions, t(215) = 3.32, p < 0.001. The Note-Only condition had a mean quality of 0.21 (SD = 0.17), higher than the Photo+Note condition, which had a mean of 0.16 (SD = 0.16). The effect size suggests a small to medium practical impact.

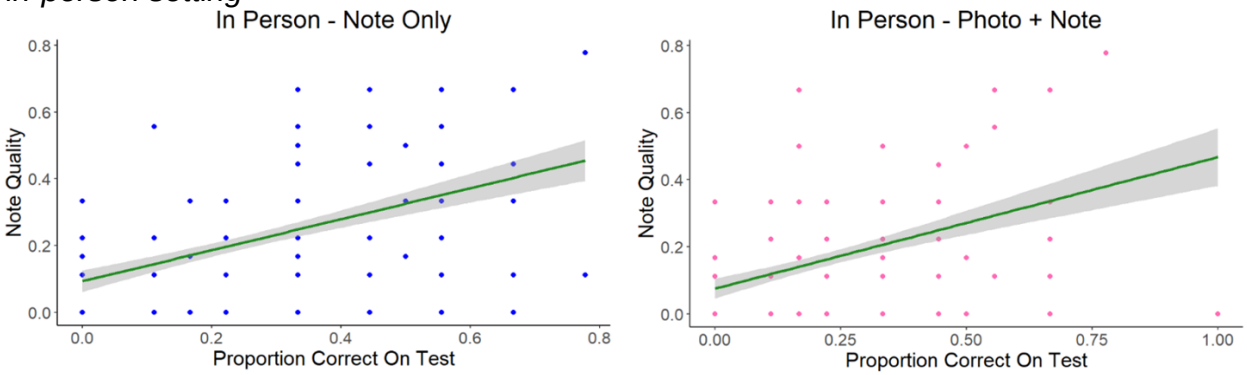
Relationship Between Note Quality and Test Performance: In-person

A positive correlation between the number of answers found in the notes and test performance was observed both when participants only took notes and when they took both photos and notes together. This correlation was found in both the in-person and online versions of the study. While the correlation was statistically significant in both scenarios, it was stronger in the Note-Only condition, $r(214) = 0.50$, $p < .001$, compared to the Photo+Note condition,

$r(214) = 0.45$, $p < .001$ (see Figure 2).

**Figure 2**

*Correlation between Note Quality and proportion of correct answers found in the final test across Note Only and Photo+Note conditions in the in-person setting*




*Note.* Significant positive correlations were observed between the number of answers in notes and test performance. The correlation was stronger in the Note-Only condition, r(214) = 0.50, p < .001, than in the Photo+Note condition, r(214) = 0.45, p < .001.

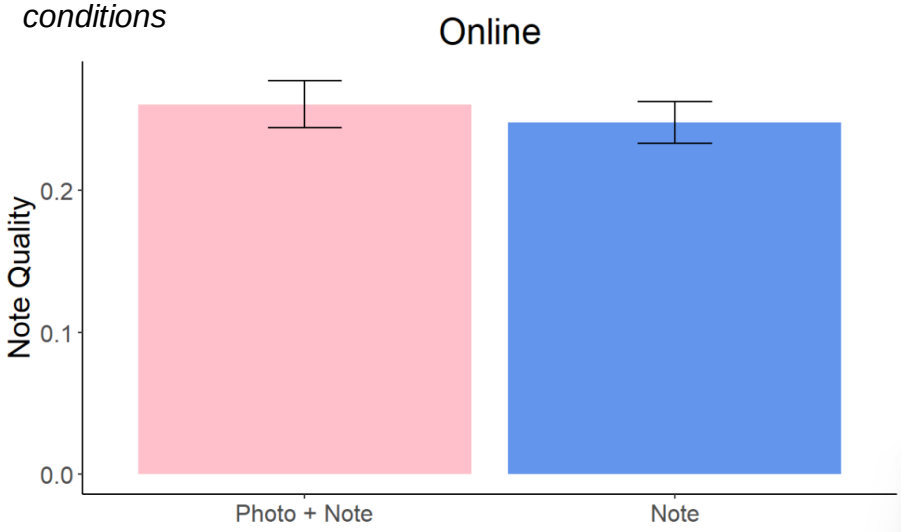
This pattern suggests that better note quality is associated with improved test performance regardless of whether participants were multitasking between note-taking and photo-taking. However, the strength of the correlation diminishes slightly when participants take both photos and notes simultaneously, implying that multitasking may slightly reduce the effectiveness of note-taking on learning. Despite the weaker correlation in the multitasking scenario, the findings consistently support the idea that more comprehensive notes contribute to better test performance.

Note Quality: Online

A paired-samples *t*-test comparing the number of answers recorded in the Note-Only and Photo+Note conditions revealed no significant difference, $t(157) = 1.17$, $p = 0.25$. The proportion of answers found in the notes for the Note-Only condition ($M = 0.21$, $SD = 0.20$) was not statistically different from the Photo+Note condition ($M = 0.19$, $SD = 0.19$; see Figure 3).

## Figure 3

*Online Note quality between Note-Only and Photo+Note conditions*




*Note.* No significant difference in the number of answers recorded between the Note-Only and Photo+Note conditions, t(157) = 1.17, p = 0.25. The means and standard deviations were similar: Note-Only condition (M = 0.21, SD = 0.20) and Photo+Note condition (M = 0.19, SD = 0.19).

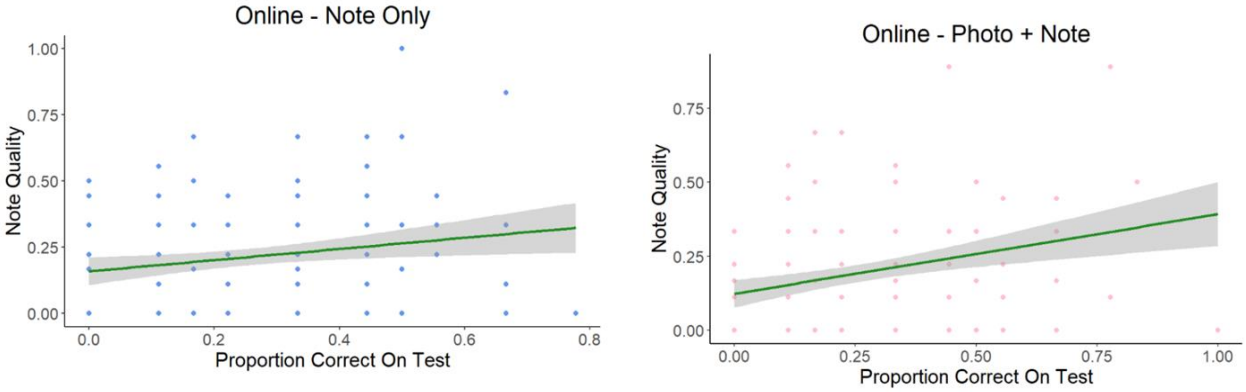
Both conditions demonstrated similar mean values, suggesting that the addition of photos to notes does not significantly decrease the quantity of notes in an online environment. These findings are notable in that they are counter to those we found in the in-person version of the study, where note-taking led to significantly more answers being recorded in the notes compared to photo- and note-taking.

Relationship Between Note Quality and Test Performance: Online

The correlation between note quality and test performance in the note-only condition was weak, but significantly positive, $r = 0.20$, $p = 0.01$. Similarly, a significant, moderate positive correlation was found between test performance and note quality in the photo+note condition, $r = 0.29$, $p < 0.001$; see Figure 4.

**Figure 4**

*Correlation between Note Quality and proportion of correct answers found in the final test across Note Only and Photo+Note conditions in the online setting*




*Note*:The correlation in the Note-Only condition was weak yet significantly positive, r = 0.20, p = 0.01. In contrast, the Photo+Note condition exhibited a moderate, significantly positive correlation, r = 0.29, p < 0.001

Together, these correlations suggest that regardless of whether participants were taking notes alone or combining note-taking with photo taking, there is a positive relationship between the quality of notes and performance on tests related to the lecture material. These findings replicate those found in the in-person version of the study and add evidence to the idea that the better one's note-taking is, the better they tend to perform on tests related to the lecture material.

## Discussion

In this study, we explored: 1) the effect of photo-taking on traditional, pen-and-paper note-taking quality, 2) the relationship between note quality and memory retention, and 3) potential differences in these effects across learning environments (in-person vs. online). We expected that: 1) taking notes alone compared to photos and notes simultaneously would lead to better note quality due to reduced multitasking, and 2) that higher quality notes would correlate with improved performance on the final memory test, irrespective of the note-taking condition or learning modality. The results were mostly in line with these predictions. We found that

participants' note quality was significantly better when they focused solely on taking notes, as opposed to when they engaged in both taking photos and taking notes; however, we only found this in the in-person study. In the online study, we found no significant difference in note quality across Note Only and Photo+Note conditions. We also found that higher note quality across all learning modalities and conditions was related to higher test performance on the final memory test.

As anticipated, the results showed that in the in-person condition, participants who focused solely on taking notes produced higher quality notes compared to those who engaged in both note-taking and photo-taking. This finding is in line with the idea that reduced multitasking between note-taking methods leads to higher quality notes. Presumably, students have more attentional resources to devote to faithfully recording the notes when they are not multitasking compared to when they are. Interestingly, we did not find this same effect in the online condition, where there was no significant difference in note quality between the Note Only and Photo+Note conditions. This finding suggests that the impact of multitasking on note quality might be less pronounced in online settings, possibly due to the different attentional dynamics involved in being in an online classroom. We speculate that in an online environment, students are less engaged with the lecture material which makes task switching between taking photos and notes less disruptive compared to task switching in an in-person environment where their engagement is relatively higher.

Overall, the hypothesized positive relationship between note quality and test performance was supported across all conditions and modalities. Our results align with previous research, such as Haynes et al. (2015), which demonstrates that more comprehensive notes are associated with enhanced learning outcomes. Previous literature also points out that the physical act of

writing can involve more cognitive processes like encoding. Rickards & Friedman (1978) notably highlighted this when they found note-taking's encoding mechanisms that aid student processing and encoding.

## Limitations

### *In-Person Environment*

When we think about how this research might inform real classroom teaching, it is important to remember that the methods used (watching recorded lectures in a synchronous environment) do not perfectly capture the dynamics of a typical classroom where the instructor is presenting the material live. While the setup of our current in-person study might resemble a real class more than a fully online study (e.g., Ditta et al., 2022), there are still some doubts about how well these findings might translate to the everyday teaching environment due to the controlled conditions of the study. For example, participants were not allowed to look back at their notes or any photos they took before their final test, which is not typically how tests are conducted in real classrooms. The ability to review notes could influence the findings related to memory retention and test performance across different note-taking conditions. If they were to review their notes before taking the memory test, it could have helped to reinforce and consolidate the information they were exposed to during the study phase of the experiment, potentially reducing differences in memory on a final test. For example, in our study, we found a significant difference between note quality when participants took only notes compared to when they took photos and notes together. If participants were allowed a chance to review their notes (and photos) before taking the test, it is possible that this difference would diminish, as participants could consolidate the information from multiple sources (photos and notes) and study anything they missed during the lecture due to multitasking. While there is some work to

suggest that reviewing notes or photos would not confer an additional memory benefit (Wong & Lim, 2021), it is unknown whether reviewing photos and notes together would benefit test performance.

*Online Environment*

In the study's online synchronous setting, the typical presence of students around in a classroom is missing, which might make students less engaged. This reduced engagement could affect how well they take notes and remember information. Similarly, various external factors like internet quality, home distractions, and the type of device used can greatly differ among participants. Additionally, in an online setting, it is more difficult to make sure that participants follow the study protocols, like when to take notes or photos, as precisely as they would in a controlled lab environment. These variables are hard to control and could significantly impact how effectively participants take notes or photos during lectures. Such influences would not have such an effect in a more controlled lab environment, where conditions are more uniform. Thus, the nonsignificant result in the online setting could have been influenced by these extraneous factors.

Future Research Directions

The study's use of immediate testing, rather than assessments spaced days or weeks after learning as is common in educational settings, might limit how well its findings can be applied to real-world educational scenarios. If students were subjected to a delayed final memory test, participants in the Note Only as well as Photo+Note would have declined test performance results in the final memory test (due to simple passage of time and the forgetting that accompanies delay; Ebbinghaus, 1964). However, participants in the Photo+Note condition might have significantly worse memory for the lecture content due to the Photo+Note

impairment effect we have observed in the in-person setting. This can be speculated due to participants having fewer opportunities to encode the lecture material because they were busy taking photos. This would in turn lessen the extent of how much information has been stored in their memory. Future studies could explore the longevity of memory effects as a result of note-taking and photo-taking practices. This would involve conducting delayed tests weeks or months after an initial lecture to examine how well information is retained over time. Such studies could help determine the optimal strategies for long-term knowledge retention, which is crucial for academic and professional success.

## Conclusion

The findings from our project revealed insights that contribute to our understanding of effective learning strategies in contemporary educational settings. First, the results indicated that there is a positive relationship between the quality of note-taking and test performance regardless of note-taking strategy (notes alone vs. photos and notes together) and learning modality (online vs. in-person). However, it is important to clarify that these findings do not establish a causal relationship. This finding corroborates that better note quality was linked to better performance on memory tests; thus, we can conclude that prioritizing more comprehensive and detailed notes can give one a higher chance of success in whichever mode of learning they find themselves in.

We also found that participants in the in-person learning setting had higher quality notes when they engaged solely in note-taking, without the distraction of photo-taking. Such outcomes highlight the cognitive benefits of active engagement with material through note-taking–but not photo-taking at the same time–which seems to facilitate deeper processing and better recall. In contrast, the online setting presented different results. Here, there was no difference in note-taking quality as a function of taking notes alone (Note Only) or photos and notes together

(Photo+Note). Future research should continue to explore these dynamics, potentially examining the long-term retention of information and the effects of various note-taking strategies across a broader range of academic disciplines and cultural contexts.

Ultimately, this study contributes to a growing body of evidence suggesting that while note-taking remains a valuable tool for learning, the method of its implementation can significantly influence its effectiveness. As educational environments continue to evolve, particularly with the increased integration of digital tools, this research serves as a critical reminder of the need to adapt teaching and learning strategies to harness the full potential of both traditional and innovative methods in promoting student success.

REFERENCES

Blankenship, M. W. (2016). Comparing note taking and test performance in methods and modes of note taking conditions. Cardinalscholar.bsu.edu. https://cardinalscholar.bsu.edu/items/574b7a63-6311-4524-95bd-24f9a63d98b1

Dagher, K. (2022). *Using the Mapping Method for Note Taking*. Fellow.app. https://fellow.app/blog/meetings/using-the-mapping-method-for-note-taking/

Ditta, A. S., Soares, J. S., & Storm, B. C. (2022). What happens to memory for lecture content when students take photos of the lecture slides? *Journal of Applied Research in Memory and Cognition*, 12(3), 421–430. https://doi.org/10.1037/mac0000069

Ebbinghaus, H. (1964). Memory: A contribution to experimental psychology. Dover https://psycnet.apa.org/record/1965-11444-000

Haynes, J. M., McCarley, N. G., & Williams, J. L. (2015). An analysis of notes taken during and after a lecture presentation. *North American Journal of Psychology*, 17(1), 175–186.

Jansen, R. S., Lakens, D., & IJsselsteijn, W. A. (2017). An integrative review of the cognitive costs and benefits of note-taking. *Educational Research Review*, 22, 223–233. https://doi.org/10.1016/j.edurev.2017.10.001

Kiewra, K. A. (1989). A review of note-taking: The encoding-storage paradigm and beyond. *Educational Psychology Review*, 1(2), 147–172. https://doi.org/10.1007/bf01326640

Manzi, A., Martinez, S., & Durmysheva, Y. (2017). Cognitive correlates of lecture note taking: Handwriting speed and attention. *North American Journal of Psychology*, 19(1), 195-217.https://www.proquest.com/scholarly-journals/cognitive-correlates-lecture-note-taking/docview/1878904220/se-2

Mfaume, H., Bilinga, M., & Mgaya, R. (2018). From Paper and Pencil to Mobile Phone Photo

Note-Taking among Tanzanian University Students: Extent, Motives and Impact on Learning. *International Journal of Education and Development Using Information and Communication Technology*, 14(2), 83–98. https://eric.ed.gov/?id=EJ1190028#:~:text=The%20findings%20revealed%20that%20mobile

Opinaldo, N. (2022). *How To Mind Map With Tony Buzan: Using 3 Simple Rules*. Gitmind.com. https://gitmind.com/tony-buzan.html

Rickards, J. P., & Friedman, F. (1978). The encoding versus the external storage hypothesis in note taking. *Contemporary Educational Psychology*, 3(2), 136–143. https://doi.org/10.1016/0361-476x(78)90020-6

Salem, R. R. (2020). Conventional, Structured and "Camera-Captured" Note-taking Methods: A Comparative Analysis. *The Normal Lights*, 14(2). https://doi.org/10.56278/tnl.v14i2.1650

Santa, C. M., Abrams, L., & Santa, J. L. (1979). Effects of Notetaking and Studying on the Retention of Prose. *Journal of Reading Behavior*, 11(3), 247–260. https://doi.org/10.1080/10862967909547328

Soares, J. S., & Storm, B. C. (2022). Does taking multiple photos lead to a photo-taking-impairment effect? *Psychonomic Bulletin & Review*, 29(6), 2211–2218. https://doi.org/10.3758/s13423-022-02149-2

Stacy, E. M., & Cain, J. (2015). Note-taking and Handouts in The Digital Age. *American Journal of Pharmaceutical Education*, 79(7), 107. https://doi.org/10.5688/ajpe797107

Tamm, S. (2021). *The Outline Note-Taking Method: A Beginner's Guide*. E-Student. https://e-student.org/outline-note-taking-method/

The Cornell Method for Note-Taking. (n.d.). Campus Life. https://www.uc.edu/campus-life/learning-commons/learning-resources/notetaking-resources/cornell-method-notes.html#:~:text=The%20Cornell%20Method%20was%20created

Wong, S. S. H., & Lim, S. W. H. (2021). Take notes, not photos: Mind-wandering mediates the impact of note-taking strategies on video-recorded lecture learning performance. *Journal of Experimental Psychology*: Applied, 29(1). https://doi.org/10.1037/xap0000375