

# The Effect of Note Taking on Memory Retention

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## Abstract

In the age of technology, students have become reliant on laptops to take notes. They do not have to worry about carrying around a binder full of paper and the notes are automatically saved on their device. While convenient, previous studies have shown contradictory results over whether the benefits of note taking by hand are also seen when taking typed notes. The present study investigated the effect of using a computer or paper to take notes and teaching note taking on memory retention. To conduct this study, 154 ninth grade students were randomly assigned to one of five conditions: no notes, handwriting notes and not taught how to take notes, handwriting notes and taught how to take notes, typing notes and not taught how to take notes, and typing notes and taught how to take notes. Participants who were taught to take notes were shown a 2.5-minute clip going over the process of outline notes. Then, all participants were shown a 15-minute video with those in note taking conditions instructed to take notes on the content presented. Afterwards, everyone was given a 10-minute test with 10 points worth of factual questions and four points worth of conceptual questions. It was found that those who did not take notes did not perform significantly differently than those who took typed or handwritten notes for factual questions, yet those who took handwritten notes performed significantly better than those who took typed notes. For conceptual questions, it was found that those who took handwritten notes performed significantly better than those who took typed notes and those who did not take notes. Additionally, it was revealed that teaching how to take notes did not have a significant impact on test performance for either factual or conceptual questions. Overall, this experiment suggests that schools should make a concerted effort to reduce the use of electronic devices in the classroom, resorting back to pen and paper.

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## Literature Review

### *Problem*

Over the past two decades, the total number of applicants applying to college increased by over 150%, causing colleges to become more competitive than ever (Selingo, 2022). With colleges becoming extremely competitive, high school students are increasing the rigor of their course loads as a way to compete with their peers. For example, the proportion of high school students taking at least one Advanced Placement course, typically seen as the highest-level course available to high schoolers, has increased from 28.6% in 2011 to 34.9% in 2021 (College Board, n.d.). Since student course loads are harder, they have to worry about absorbing more information through the practice of notetaking during lectures (Akintunde, 2013). However, in recent years, the

landscape for notetaking has greatly changed. For one, the rise of technology means there is a greater availability of internet resources, such as Google Classroom, which allows information, which previously could only be accessed during a lecture, to be posted online (KIPP NJ, 2016). Therefore, notetaking is no longer the sole method of revisiting information, which was previously one of the major benefits of notetaking (Jacobs, 2008). As a result, the practice of notetaking has been increasingly questioned and its importance has declined in school curricula (Singer & Samson, 2019). Additionally, the rise of technology means that the use of laptops and tablets in schools have greatly increased, resulting in the number of students who type their notes to also increase (KIPP NJ, 2016). However, there is disagreement over the difference in effectiveness of typing versus handwriting notes (Mueller & Oppenheimer, 2014; Urry et al., 2021). Therefore,

the purpose of this study was to determine how the different ways of recording notes and being taught to take notes affects memory retention.

### *Notetaking on Retention of Information*

While there is growing skepticism towards the practice of notetaking (Singer & Samson, 2019), it has been found to increase the retention of information regardless of the type of notes one takes. Some suggest it is because notetaking allows students to process the information by summarizing and synthesizing it (Jacobs, 2008). Others suggest that notetaking is beneficial because it allows students an opportunity to record information so that it is accessible when needed to study for a test (Jacobs, 2008). For the most part, students who take notes do better on both essay and multiple-choice tests. For instance, Akintunde (2013) found that on a multiple-choice test based on a video about stress, those who took handwritten notes did significantly better on the test with an average score of 6.5 out of 10 than those who did not take any notes who had an average score of 5.25 out of 10. On the essay test, those who took handwritten notes also did significantly better as they had an average score of 11.98 out of 15, while those who did not take notes had an average score of 10.95 out of 15 (Akintunde, 2013). The improvement in test performance caused by note-taking was also seen in another study where college students took a test on a lecture. Those that took notes had a mean score of 15.3 while those who did not take notes had a mean score of 12.4 (Fisher & Harris, 1973).

### *Type of Notes*

While there is agreement that taking notes is significantly more beneficial than not taking notes, the rise of technology has changed the practice of note taking with the introduction of typing notes (KIPP NJ, 2016). Studies investigated the effect of typing and handwriting notes on the ability to answer factual questions and found handwriting notes does not significantly improve test performance compared to typing notes (Mueller & Oppenheimer, 2014). Replications of this study by Mitchell and Zheng (2017) and Urry

et al. (2021) also found that there was no significant difference between handwriting and typing notes when it came to factual questions.

On the other hand, studies that have compared the effect of typing to handwriting notes on students' test performance on open-ended, conceptual questions have found contradictory results. Oppenheimer and Mueller (2014) found that for conceptual questions, those who typed their notes did significantly worse than those who handwrote their notes. The study also found that students who typed notes on a video had an average of 14.6% verbatim overlap while those who hand wrote their notes only had an average of 8.8% verbatim overlap (Mueller & Oppenheimer, 2014). These findings suggest that handwriting notes results in more processing and less passive typing of what the lecturer says, which may have caused students who took handwritten notes to remember more conceptual material (Mueller & Oppenheimer, 2014). Another study found through a meta-analysis of 14 experimental design studies that compared to typing notes, handwriting notes resulted in 9% more college students getting an A or B in their class (Allen et al., 2020). Allen et al. (2020) suggested this difference could be attributed to the fact that handwriting notes is not as distracting as typing notes because applications and notifications are readily available on a computer unlike with pen and paper. However, other studies found that there is no significant difference between typing and writing notes when answering conceptual questions. For example, multiple replications of Oppenheimer and Mueller's experiment (2014) found no significant difference exists between taking handwritten notes and typed notes (Mitchel & Zheng, 2017; Urry et al., 2021). Although there is contradictory research, there is more evidence to support the idea that handwriting notes will have a positive impact on retention compared to typing notes especially since the study conducted by Allen et al. (2020) is a meta-analysis of multiple different experimental studies which all suggest the benefits of handwriting outweigh that of typing.

### *Taught vs. Not Taught*

While it is suggested that note taking is a beneficial practice, most students take bad notes, missing the most important ideas which reduces the effectiveness of such notes (Robin et al., 1977). However, it has been shown that students who are taught how to take notes tend to take better notes containing more of the important ideas, resulting in greater retention of information (Robin et al., 1977). For example, one study taught students how to record and recognize the most important information in a lecture by hosting five practice lectures where they first gave the students an outline of what notes to take and then gradually reduced the outlines until the students were on their own. They measured note-taking quality in critical idea units (ideas that are essential to the lecture), finding that after teaching underachieving college students how to take notes, their notes contained 28.3% more critical idea units than a group that was not taught how to take notes (Robin et al., 1977). Another study found that when one is instructed how to take notes, the usefulness of such notes increases, leading student performance on tests to improve (Chang & Ku, 2014). In the teaching note-taking group for this study, participants were given instructional material which compared good notes, which contained the essential ideas, to bad notes, which lacked those ideas. Those who were instructed on how to take quality notes scored significantly higher on a reading comprehension test, with a mean score of 12.3, than those who were not taught how to take quality notes, with a mean score of 10.8 (Chang & Ku, 2014). Contrary to the aforementioned studies, the current study utilized a different approach, using a short video to teach notetaking rather than physical handouts with follow-up lectures. A video was used to ensure that the “teaching” each participant in the teaching conditions got was identical. Additionally, the rise in technology in classrooms has also led to many lessons being taught via video, with videos becoming regularly used in 79% of classrooms (Schaffhauser, 2019). Therefore, a video was used in this study to mimic the likely method in which note taking will be taught in the future. The current study also was conducted in a high school atmosphere, unlike the two mentioned studies

which utilized college and elementary school students.

### *Hypotheses*

In the current study, groups were taught to take notes and follow the outline method. They were instructed to follow this method because it is one of the most popular note-taking strategies in the college and high school atmospheres (GoodNotes, 2018). Additionally, multiple other studies, such as that conducted by Akitunde (2013), utilized outline notes. In this method, information is bulleted with the least general information beginning at the left and more specific information indented to the right (Akitunde, 2013; GoodNotes, 2018). The following hypotheses were tested: *Hypothesis 1*: Those who handwrite their notes will not perform significantly different on factual questions than those who type their notes, but they will both perform significantly better than those who do not take notes. *Hypothesis 2*: Those who are taught how to take notes will do better on factual and conceptual questions than those who are not taught how to take notes

### **Method**

#### *Participants*

One hundred fifty-four students were recruited from a suburban high school’s 9th grade English classes. Such classes were used as the 9th grade English classes are heterogeneously grouped, providing a mix of students of all academic abilities.

Participants in the study were told that the study would “examine how well they can retain information from a video.” They were also notified that they would be taking a test after the video that would measure how well they could remember and apply what was said in the video. To incentivize participation in the study, participants were told that at the end of the study they could enter a raffle to win a \$25 Amazon gift card. They entered the raffle by filling out a ticket with their school email address, and the winner was notified.

### *Experimental Manipulation*

This study had two independent variables. The first was whether the student took no notes, handwritten notes, or typed notes. The second was whether or not the student was taught to take notes. Each of the seven classes were randomly assigned to one of five conditions: no notes, handwriting notes and not taught how to take notes, handwriting notes and taught how to take notes, typing notes and not taught how to take notes, and typing notes and taught how to take notes. Three of the seven classes were randomly assigned to a condition that required them to be taught how to take notes. Consequently, they were shown a video that explained how to take outline notes. The video, which was approximately 2.5 minutes long, was titled “Formal Outline” and went through the goal of taking and formatting outline notes and provided a comprehensive and high-quality example of such notes (Ferreira, 2014).

### *Procedure*

To test the effectiveness of the note taking strategies on memory retention, participants watched a video on the Indus River Valley. Prior to watching the video, those assigned to handwriting notes conditions were given a pen and paper to take notes with, those assigned to typing notes conditions were told to take out their school supplied laptop to take notes with, and those assigned to the no notes condition were instructed to completely clear their desk and provide their undivided attention to the video. All participants then watched the video titled “Computing a Rosetta Stone for the Indus Script.” This video was approximately 15-minutes in length and was chosen because it is about ancient history, which is loosely related to the 9th grade ancient literature curriculum (Rao, n.d.). This video was also used as it is the same video used in the study conducted by Mueller and Oppenheimer (2014). The video discussed the fact that the language of the Indus River Valley civilization has not been decoded and the different methods in which it may be decoded in the future.

After participants watched the video and took notes, they completed a short answer test based off of the video. They had no time to review their notes and did not use their notes or any other outside information during the test. The test was taken from the study conducted by Mueller and Oppenheimer (2014) and was out of 14 points with 10 points based on factual information and the other four points based on conceptual information (see Appendix). Factual questions were questions that were directly answered by the video while conceptual questions were questions that took the information said in the video and required it to be applied to the questions.

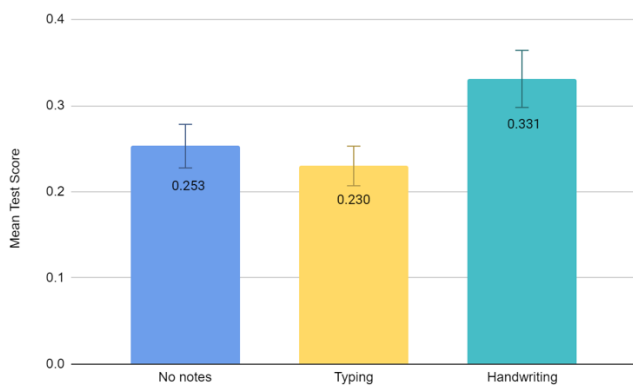
### *Data Analysis*

To investigate the impact of note taking on memory retention, univariate ANOVAs with subsequent post hocs and independent sample t-tests were used. The univariate ANOVA was used to compare the no notes, handwriting, and typing average test scores for both conceptual and factual questions. Independent sample t-tests were used to compare the taught conditions to the not taught conditions. A significance level of  $\alpha = .05$  was used, and error bars on the graphs show  $\pm 1$  standard error.

## **Results**

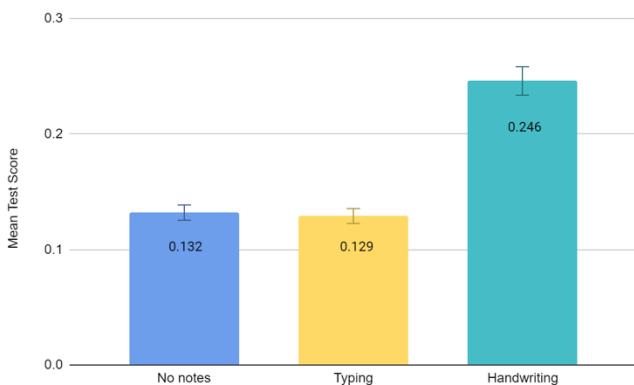
### *Type of Notes*

A one-way ANOVA showed that the effect of note type on test score for factual questions is significant,  $F(2, 155) = 3.34, p = .04$ . Subsequent post hocs revealed that those who took handwritten notes performed significantly better on factual questions than those who took typed notes. Students who did not take notes scored an average of 25.3%, and students who took typed notes scored an average of 23.0%, while students who took handwritten notes scored an average of 33.1% (Figure 1). These results do not support hypothesis 1a in that those who took handwritten notes performed significantly better than those who took typed notes.



**Figure 1. The Effect of Type of Notes on Factual Test**

Another one-way ANOVA showed that the effect of note type on test score for conceptual questions is significant,  $F(2,155) = 4.34, p = .02$ . Subsequent post hoc tests showed that those who took handwritten notes performed significantly better than those who took typed notes and those who did not take notes for conceptual questions. Students who did not take notes scored an average of 13.2%, and students who typed notes scored an average of 12.9%, while students who hand wrote notes scored an average of 24.6% (Figure 2). These results substantiated my hypothesis that those who took handwritten notes would perform significantly better than those who took typed notes and no notes for conceptual questions. Yet, my hypothesis was not supported in that those who took typed notes did not perform significantly differently from those who did not take notes.

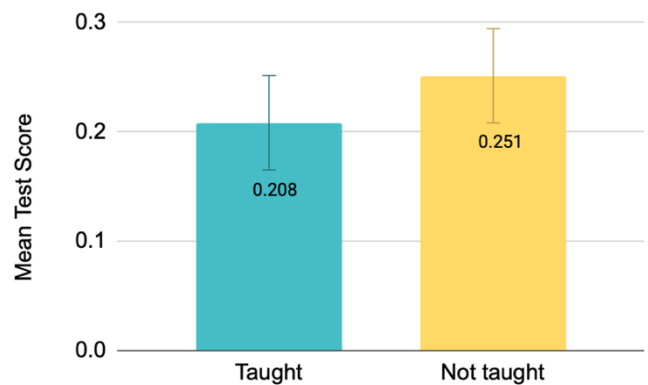


**Figure 2. The Effect of Type of Notes on Conceptual Test Score**

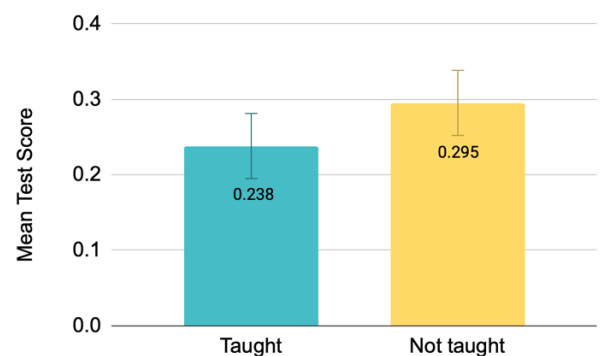
*Taught vs Not Taught*

Students who were taught to take notes did no better on the exam questions than students who were not taught to take notes. An independent samples t-test found that being taught to take notes did not significantly improve test performance compared to not being taught to takes notes for factual test questions,  $t(153) = 1.48, p = .14$ , with students who were taught to take notes scoring an average of 23.8% and those who were not taught to take notes scoring an average of 29.5% (Figure 3).

Another independent sample t-test revealed that being taught to take notes did not significantly alter test performance compared to not being taught to take notes for conceptual test questions,  $t(153) = -0.76, p = .45$ . Students who were taught to take notes scored an average of 20.8%, while students who were not taught to take notes scored an average of 25.1% ( Figure 4). These results refuted my hypothesis that those who were taught to take notes would perform significantly better than those who were not taught to take notes for both factual and conceptual questions.



**Figure 3. The Effect of Teaching Note Taking on Factual Test Score**



**Figure 4. The Effect of Teaching Note Taking on Conceptual Test Score**

## Discussion

### *Type of Notes*

The data gathered from the study refuted hypothesis 1a in the respect that for factual questions, those who took handwritten notes performed significantly better than those who took typed notes, but neither performed significantly differently from those who did not take notes. The finding was unexpected as previous literature found that those who took handwritten notes and those who took typed notes did not perform significantly differently on a memory retention test for factual questions (Mitchell & Zheng, 2017; Mueller & Oppenheimer, 2014; Urry et al., 2021). Additionally, it was unexpected as previous literature suggested that note taking led to the synthesis and processing of information (Jacobs, 2008), causing those who take notes, both handwritten and typed, to perform better on memory retention tests than those who do not take notes (Akintunde, 2013; Fisher & Harris, 1973).

A possible explanation for the unexpected finding is that during the video of the Indus River Valley Civilization, participants who were typing notes often seemed very distracted, and their eyes rarely left their computer screens. Therefore, participants who took typed notes could have performed worse for factual questions than those who took handwritten notes because they may have been distracted by gaming, messaging, and social media applications on their device, resulting in them being off task and not paying attention to the video. To explore this possibility, further research should be conducted comparing test performance of students typing on devices with internet access to those typing on devices without internet access.

Additionally, taking notes did not significantly alter test performance compared to not taking notes for factual questions which may have been because participants who took notes were fixated on getting the perfect notes and were caught up in the details of the notes causing them to not pay attention to the video on the board. The no notes group, however, was able to provide their

undivided attention to the video allowing them to retain the factual information presented in the video (DeWitt, 2007). Therefore, the greater attentiveness of the no-notes group possibly counteracted the processing benefit faced by the note taking groups for such questions.

As expected, those who took handwritten notes performed better than those who took typed notes and those who did not take notes for conceptual questions on the test, thus substantiating hypothesis 1b. Unlike what was expected, students who did not take notes performed no worse than students who typed their notes, refuting hypothesis 1b. It is unsurprising that those who took handwritten notes performed better than those who took typed notes as past literature, such as the study conducted by Jacobs (2008), suggested that those who handwrite their notes cannot keep up with the lecturer, so they are forced to synthesize the information rather than typing it verbatim. The synthesizing of information results in thoughtful processing of it as it forces one to consider how to best condense the information to record it in a timely manner. On the other hand, typing notes verbatim is a thoughtless process which requires simply recording whatever comes out of the mouth of the lecturer. Additionally, those who took typed notes appeared very distracted by the device they were taking notes with which could have resulted in them being off task and not paying attention to the video. Due to the extra synthesis necessary and the fewer distractions available, those who took handwritten notes performed significantly better than those who took typed notes for conceptual questions. It was also foreseeable that the handwriting condition would perform significantly better than the no notes condition as handwriting notes results in the processing and retention of information (Jacobs, 2008).

The finding that typing notes did not improve students' performance as compared to not taking notes suggests that the distractions of using an electronic device may minimize the processing benefit of note taking. While taking notes would be expected to be beneficial as note taking helps retain and process information (Jacobs, 2008),

using devices in the classroom can be very distracting (Awwad et al., 2013). The fact that the devices were distracting likely reduced any processing and retention benefits of note taking as students did not provide their full and undivided attention to the video and task at hand. On the other hand, while the no notes group did not have the processing benefit of note taking, they had the benefit of closely watching the video. As a result, the no notes group performed similarly to the typing group.

### *Taught vs. Not Taught*

The data from the study refuted hypothesis 2 as no significant difference was found between the taught and not taught conditions in terms of test performance for both factual and conceptual questions. The finding was unexpected as previous literature suggested that being taught to take notes would improve one's notes resulting in the processing benefit of note taking being more profound (Chang & Ku, 2014; Robin et al., 1977).

The likely reason for the insignificant difference was that a three-minute video with no practice may be insufficient to teach the process of note taking. Past literature employed interventions to teach the proper taking of notes which took place over many weeks, whereas this study employed a short video to ensure that the same thing was taught to each class in the teaching condition and to reduce the amount of class time that this study interfered with. It is possible that since the participants had no time to practice taking notes using the strategies they were taught, the teaching manipulation was not very effective.

typed notes, but neither performed significantly differently from those

### *Strengths and Limitations*

This study is notable because it addresses the dispute over whether handwriting notes are beneficial for answering conceptual questions compared to typing notes. Studies have employed this same method and found contradictory results with some studies finding that handwriting notes does significantly improve test performance for

conceptual questions compared to typing notes (Allen et al., 2020; Mueller & Oppenheimer, 2014), while other studies suggest that there is no significant difference between handwriting and typing notes for such questions (Mitchell & Zheng, 2017; Urry et al., 2021). This study supported literature suggesting that handwriting notes do significantly improve test performance for conceptual questions compared to typing notes. Also, this study disputed the results of previous studies which suggested no significant difference would be found between handwriting and typing notes for factual questions (Allen et al., 2020; Mitchell & Zheng, 2017; Mueller & Oppenheimer, 2014; Urry et al., 2021). Therefore, this study can be used as a basis for future research aiming at whether handwriting notes positively affects one's performance for factual questions.

One limitation of the study was the inability to analyze the notes of each participant for idea units and verbatim overlap. Idea units are considered main ideas in the video, and each participant's notes would be analyzed to determine how many of these units their notes cover. Additionally, it would be interesting to analyze verbatim overlap by looking for any phrases in one's notes which were taken word-for-word from the lecture. Checking for verbatim overlap would be important as by copying the words of the video, it reduces the processing benefit of note taking as such processing is the result of synthesizing material to include on the notes. Analyzing the notes of each participant may have explained why the taught and not taught conditions had, on average, similar test scores as it is possible that the teaching manipulation was not effective which would be evident by an insignificant difference in the average number of idea units and verbatim overlap in the notes in each condition. Additionally, if the notes were analyzed and the typing condition had, on average, significantly more verbatim overlap than that of the handwriting condition it would provide evidence to suggest that typing notes results in more copying word-for-word and, therefore, leads to less processing.

### Future Study

In a future study, one could test different note taking techniques. Specifically, one could test Cornell notes, outline notes, and diagram-based notes as those are the most common methods of note taking (GoodNotes, 2018). Identifying the best note taking technique can help provide teachers and students with guidance and advice when deciding how they will teach notes and take notes, respectively.

Another possible future study would be to examine how different teaching styles to teach notes affects how well students take notes. One could test the difference between a lecture, a video, and a handout on how well students take notes as those are the three teaching methods with the most background literature (Chang & Ku, 2014; Robin, et al., 1977). The results from this study would be particularly useful for teachers in advising them on how to most effectively teach their students how to take quality notes.

Lastly, in a future study, one could test typing on devices with and without internet access and see how they differ in terms of average test performance. This comparison would help provide insight as to why typing notes was found to be overall less effective than handwriting notes. If the group without access to the internet, on average, performs significantly better on the memory retention test than the group with access to the internet, then it could be safely concluded that since distracting applications such as games, messaging, and social media are easily accessible on devices where students often type notes, it results in typing notes being less effective than handwriting notes.

### Conclusion

The findings suggest that teachers should limit the use of electronic devices in the classroom as they do not help students retain information and probably serve as a distraction. In terms of teaching note taking, it is likely that further research is needed to test different methods of teaching and compare the resulting notes to

determine the most effective method. The results also suggest that in some cases involving more factual based information, providing one's undivided attention to the video can be a useful alternative to note taking. However, in terms of conceptual based questions, the results reaffirm the importance of note taking.

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