

Note-Taking Strategies in a Lecture Environment

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Abstract

Previous studies have provided inconsistent results regarding the best method for note taking. Further, it has been suggested that being tested in an environmental setting congruent to that in which learning occurred results in better recall. This study examined the effects of different note-taking strategies (handwritten, typed, listen only) on recall. In addition, tests were either using a method congruent to the learning condition or incongruent. Participants watched a short video and were tested using multiple choice and application questions to determine whether different note-taking strategies or testing methods had an effect on the ability to recall and apply lecture material. A main effect of note-taking was found, suggesting that participants who listened to the lecture performed significantly better overall compared to those who took handwritten notes. No other significant differences were found. Considering the inconsistencies in the research as to which note-taking method is most beneficial, perhaps the lecture material itself (e.g., fact based, abstract, or subject material) may be a variable that influences note-taking success.

Note-Taking Strategies in a Lecture Environment

Historically, many cultures have relied on their memory of the information contained in oral techniques, such as storytelling, to share information between members. As research has progressed, it is known that our working memory has a limited capacity. Information is stored in working memory for a limited amount of time, which can be increased if there is an opportunity to rehearse (McLeod, 2009). Since receiving an education provides important social and preparation tools that are beneficial in everyday life, finding the most beneficial method for remembering information over a long period of time is ideal. The act of writing down information for future reference has been referred to as the hypomnematic function, which Plato used as a method to bring information back into the mind (Reale, 1990). The act of writing information down is not a new technique, however, there still is not a clear understanding of how writing information down affects attention and the ability to recall information. If note-taking acts as a distraction and affects the ability to properly attend to the lecture, then the next step is for the research to focus on ways to increase attention to the lecture material without taking notes. If note-taking is a beneficial tool, the context and ways in which notes should be taken should be the next step (Di Vesta & Gray, 1972).

Researchers have examined the role note-taking plays in participant's performance on information recall in many different situations and have been met with contradicting results. Studies have shown that note-taking improves test performance. Overall, note-taking increases the amount of information a participant is able to recall. Note-taking also increases performance when a rehearsal period is introduced before testing compared to those who just listen (Di Vesta & Gray, 1972, 1973; Kiewra et al., 1991). The note-taking condition also showed better test performance on problem solving and application questions, whereas the listening condition

performed better on fact retention and semantic recognition (Peper & Mayer, 1978, 1986; Shrager & Mayer, 1989). However, Aiken et al. (1975) found no significant difference between the participants that took notes during the lecture and those who listened, which is a direct contradiction of previous research (i.e., Di Vesta & Gray, 1972, 1973; Kiewra et al., 1991; Peper & Mayer, 1978, 1986; Shrager & Mayer, 1989).

Examining when note-taking is the most efficient, Eisner and Rohde (1959) looked at the effects note-taking had on recall when notes were written during the lecture and when they were written after. They concluded that their results did not demonstrate any significant benefits of taking notes during a lecture when it came to recall performance and could quite possibly act as a distractor. In contrast to the lack of significance reported by Eisner and Rohde (1959), Aiken et al. (1975) found evidence for the contrary. The participants that took notes after each lecture segment performed significantly better than those who took notes during the lecture. The evidence thus far has focused on whether note-taking is beneficial, and has not looked at the reasons why.

Researchers began to develop theories as to why note-taking is a beneficial tool (Di Vesta & Gray, 1972, 1973; Kiewra et al., 1991; Peper & Mayer, 1978, 1986; Shrager & Mayer, 1989). The generative theory states that the act of taking notes is a generative technique. This means that the way in which new information is encoded and assimilated with existing information creates new more complex representations for note-takers. Furthermore, those who are listening to the information are encoding it as the information is presented which generates more simplistic representations (Peper & Mayer, 1978, 1986). Thus, it would be expected that such a theory would imply there would be qualitative differences in learning outcomes. Information is assimilated into existing experiences and knowledge when the note-taking strategy is used.

These individuals perform better on far-transfer tasks which require the manipulation of information in order to successfully answer problem-solving and application questions (Peper & Mayer, 1978, 1986; Shrager & Mayer, 1989). Furthermore, individuals who only listen to the lecture material and as a result encode the information while it is being presented will perform better on near-transfer tasks. These tasks do not require any manipulation of information to successfully answer questions based on fact retention or verbatim recognition (Peper & Mayer, 1978, 1986; Shrager & Mayer, 1989). This theory implies that connections are made and summarized when notes are taken, however, they lose some of the finer details (facts) that those who only listen are able to retain.

In addition, other explanations suggest that note-taking is a beneficial learning tool because it serves either or all three learning mechanisms external storage, encoding, and encoding plus storage (Di Vesta & Gray, 1972, 1973; Kiewra et al., 1991). Note-taking can enhance the information available in external storage when given time to review. This enhancement results in better test performance compared to those that reviewed from memory (Di Vesta & Gray, 1972, 1973; Kiewra et al., 1991). With encoding, note-taking allows for interpretations, thoughts, and associations to be written down while the material is being presented, which would also be encoded (Di Vesta & Gray, 1972, 1973). Thus, encoding plus storage, the most effective learning outcome of the three, is enhanced if there is time for review since these interpretations, thoughts, and associations would help to solidify the encoding process (Kiewra et al., 1991). Research has mainly focused on the effects hand written notes have on these different learning mechanisms (Aiken et al., 1975; Di Vesta & Gray, 1972, 1973; Eisner & Rohde, 1959; Kiewra et al., 1991; Peper & Mayer, 1978, 1986; Shrager & Mayer, 1989) and only recently, as the accessibility of technology increases (“College Students,” 2013;

“Laptops Move,” 2014), has research started to explore the effects typed notes have on each of the learning mechanisms (Bui, Myerson, & Hale, 2013; Mueller & Oppenheimer, 2014).

Research has found that 85% of college students own a laptop, 70% own a smartphone, followed by the ownership of tablets at 36%, and all are on a rising trend (“College Students,” 2013; “Laptops Move,” 2014). Additionally, students at the undergraduate, graduate, or community college level are all more likely to access the internet and own a laptop in comparison to all adults and non-students (Smith, Rainie, & Zickuhr, 2001). Thus, with this increase in accessibility to technology, little research has examined the role it plays in the classroom with respect to note-taking and test performance.

The findings from the research conducted thus far comparing hand written notes and typed notes has not provided a clear indication of whether one is superior to the other (Bui, Myerson, & Hale, 2013; Mueller & Oppenheimer, 2014). Typed notes are more likely to contain more information, however, they are also more likely to contain more verbatim overlap due to transcription of the lecture. Handwritten notes, on the other hand, are more likely to contain less information and have less verbatim overlap (Mueller & Oppenheimer, 2014). With respect to factual retention and free recall, the research has produced contradicting results. Mueller and Oppenheimer (2014) found no differences between hand written notes and typed notes, whereas Bui et al. (2013) found that those who typed their notes were able to recall more information than those who wrote their notes. When the results from application questions were analyzed it also showed a contradiction. Research has not only shown that those that used a laptop to take notes performed much worse than those who had written their notes by hand (Mueller & Oppenheimer, 2014), but it has also been shown that those who type their notes perform much better than those

who wrote their notes by hand (Bui et al., 2013). Once additional variable manipulations were added, again it caused additional contradictions within the research.

Once a study period was introduced before testing, those who had typed their notes performed better overall (Bui et al., 2013). However, it has also been shown that when those who handwrote their notes are given a study period before testing they perform better overall (Mueller & Oppenheimer, 2014). Looking at transcription versus summary note-taking, when a test was given after a 24 hour time delay, those who had transcribed the lecture did significantly worse than when they were tested immediately after (Bui et al., 2013). From the research presented, it is clear that there is still not known which note-taking method is most beneficial.

The purpose of the present study is to explore the differences in test performance on multiple choice and application style questions between those who take notes by hand, by computer, or just listen to the lecture. Furthermore, an additional aspect that is being added is a testing condition (i.e., handwritten test, typed test) to examine the possibility of a situational affect. In addition, although previous studies have looked at written notes and typed notes and application test questions, the lecture material has been fact based. Thus, in this study a more abstract lecture is being used which ties many concepts together in an unconventional way. Using this type of lecture might increase the ability to make deeper connections and critically analyze the content that is being presented as opposed to just absorbing facts. The goal is to add to the existing body of knowledge on the situations and ways in which note-taking is the most beneficial.

Methods

Participants

Sixty-three undergraduate students from Algoma University volunteered to participate in this study. The participants consisted of 46 females ($M_{age}= 20$) and 16 male participants ($M_{age}=$

20.5) and one that identified as other ($M_{age} = 18$). Participants were randomly assigned to one of six groups ($n=10$). The data from three participants were excluded due to not following instructions which were pertinent to the condition they were in (e.g., not taking notes or not taking the test seriously or not completing the test).

Materials

A computer lab that contained computers set up with lecture style seating was used. Each individual station was equipped with Dell Intel desktop computer with a 19 inch monitor. Participants were shown a downloaded copy of a 17 minute and 30 second TED talk by Malcolm Gladwell titled “Choice, Happiness, and Spaghetti Sauce” (http://www.ted.com/talks/malcolm_gladwell_on_spaghetti_sauce?language=en) using a standard video projector. Participants were given a test on the material which was created using word processing software (Microsoft Word 2010). Two versions of the test were used, one for the written test and another for the typed test which included check boxes for the multiple choice questions (see appendix A for test questions). Participants were also given a demographic survey regarding details of their academic performance (see appendix B for survey questions).

Procedure

This study was a 3 x 2 between subject design, three note conditions (handwritten notes, typed notes, listen only) by two testing conditions (handwritten test, typed test). Participants were seated in a computer lab at individual computer stations. All participants were shown a 17 minute and 30 second video using a projector without interruptions. There were three different sets of instructions given to participants regarding what was required of them during the video. The first group was instructed to take notes on any information they felt was important using the pen and paper provided. The second group was also instructed to take notes on any information

they felt was important, however, they were required to type their notes on a blank document provided on their computer. Finally, the third group was instructed to listen and pay attention to the video and to not take notes. For each of the three note-taking conditions one of two different testing conditions was administered. Half of the participants in each of the note-taking conditions were given a test to be completed by hand and the other half of the participants were given a test to be completed on the computer. After participants completed the test they were given a demographic survey that asked their age, major, how many years have they attended Algoma University, and if and how they normally take notes.

Results

A repeated measures ANOVA was conducted on note-taking (handwritten, typed, and listen only) x test method (handwritten, typed) on multiple choice and application scores. A main effect of note-taking was found, $F(2, 54) = 3.87, p < .05$. Those who listened to the lecture performed significantly better than those who hand wrote their notes, $p < .05$. On the other hand, those who handwrote their notes did not differ from those who typed their notes, $p > .05$, and those who typed their notes did not differ from those who just listened to the lecture material, $p > .05$. (see Figure 1). There was no effect of the test method used, $F(1, 54) = 0.389, p > .05$. No other main effects or interactions were statistically significant, all p 's $> .05$ s.

Discussion

The current study hypothesized that those who took notes would perform better on overall test performance than those who just listen to the lecture material. Additionally, it was predicted that those who handwrite their notes would perform better than those who type their notes. Furthermore, it was predicted that there would be a context effect between whether the note-taking method (handwritten, typed, or listen only) and testing method (handwritten or typed) were congruent or incongruent. The congruent conditions (e.g., handwritten notes and

handwritten test) would show better test performance than the incongruent conditions (e.g., handwritten notes and typed test). The results found in the current study revealed no significant differences between handwritten notes and typed notes, and no significant effects of congruent or incongruent testing contexts. However, there was a significant difference found between the handwritten condition and the listening condition that was in the opposite direction from what was expected. The listening only condition performed better overall than those who handwrote their notes. These results do not give a clear indication of the effectiveness of each of the note-taking method.

Examining the findings from the previously discussed literature, there is no clear indication as to which note-taking method is the most beneficial. Multiple note-taking methods have shown superior performance on the same aspect of test performance in different pieces of research. For example, it was found that those who handwrote their notes recalled more information than those who just listened and those who types their notes recalled more information than those who handwrote their notes (Di Vesta & Gray, 1972, 1973; Bui et al., 2013). However, research has also failed to find a significant difference in recall of information between those who handwrote their notes and those who typed their notes (Mueller & Oppenheimer, 2014).

Breaking down test performance scores into performance on specific types of questions, the research has also shown mixed results. Those who handwrote their notes performed better on multiple choice or fact retention questions in comparison to those who just listened (Di Vesta & Gray, 1972, 1973). However, it has also been found that those who listened to the lecture material performed better than those who handwrote their notes on multiple choice questions (Peper, & Mayer, 1978). Furthermore, those who typed their notes performed better on fact

retention when compared to those who handwrote their notes (Bui et al., 2013). The question that still remains is whether or not, if all three note-taking conditions were examined at once, it would show that those who write notes by hand will perform the best? From the results found in the current study, there were no significant differences between any of the groups with respect to multiple choice or fact retention questions.

It has also been found that those who handwrote their notes performed better on application and problem solving type questions (Mueller & Oppenheimer, 2014; Peper & Meyer, 1978, 1986). The results from the current study did not find the same results. The three note-taking conditions did not show any significant differences on performance when specially looking at application style questions. However, although there were no significant differences between the groups there is a trend in the opposite direction from what has been found in previous research (see Figure 2). The results showed that those who listened to the lecture material performed the best, followed by those who typed their notes, and lastly those who handwrote their notes.

Aside from examining the effectiveness of each of the note-taking method, the lecture material might itself create differences between the effectiveness of each. Di Vesta and Gray (1973) examined how the degree of relatedness between the lecture segments presented to participants effected recall. They found that the more unrelated the lectures were to one another it resulted in better recall and test performance.

The levels of processing theory states that we can encode information in a shallow or a deep manner. Shallow processing is structural encoding. Therefore, you recognize features such as the colour of the text, which letters are capitalized, which letters are in lowercase, and which words rhyme with each other. Deep processing on the other hand is semantic encoding. You take

the information you hear and see and think about it and elaborate on it. You think about how it relates to other concepts or previous experiences which leads to better memory for the material (Craik & Lockhart, 1972).

The results Di Vesta and Gray (1973) found could indicate that the more unrelated the lecture material is the more likely you are to think about how each of them can be applied to previous knowledge, concepts, or experiences. Therefore, if the lecture material is abstract or conceptual, as opposed to fact based, it could influence how participants in all note-taking conditions perform on fact recall and application questions. It could also lend an examination for the results found in the current study. If an abstract lecture sparks deeper thought about the content it could be possible that listening to the material could be the most beneficial note-taking method due to taking notes by hand or by computer acting as more of a distraction.

This is the first study that I am aware of that has combined all three note-taking methods using abstract lecture material. Previous studies have used lecture material that involved topics such as the workings of a camera, car engine, hair seals, bow porcelain, history of fine arts, nonfiction book passages relating to the Crimean War, and survival among sharks (Bui et al., 2013; Di Vesta & Gray, 1972, 1973; Peper & Mayer, 1986). It is possible that one of the reasons this study found that those who listen to the lecture material perform better than those who take notes by hand could be simply due to the level of interest. Just listening to an abstract lecture might have allowed the participants to think about the information being presented, and it is possible that taking notes by hand might have acted as more of a distraction.

The next step with this research would be to lengthen the retention interval to simulate real life situations. Whether it is with respect to lectures or business meetings, there is usually a decent amount of time between learning information and being tested on it or having to recall

and apply it. This study used immediate recall, which is when we remember the largest amount of information we have heard, however, over time information decays. Bui et al. (2013) found that those who transcribed the lecture material performed significantly worse when tested 24 hours later than they did at immediate recall. Thus, it is possible that if this study was replicated with a longer retention interval it might reflect the previous findings. Additionally, it is possible that the rate of information decay when using a conceptual lecture might show different results across the three note-taking methods. Considering the inconsistencies as to which note-taking method is most beneficial, perhaps it is the lecture material itself (e.g., fact based, conceptual, or subject material) that may be a variable that determines the success of different note-taking strategies.

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Figure 1

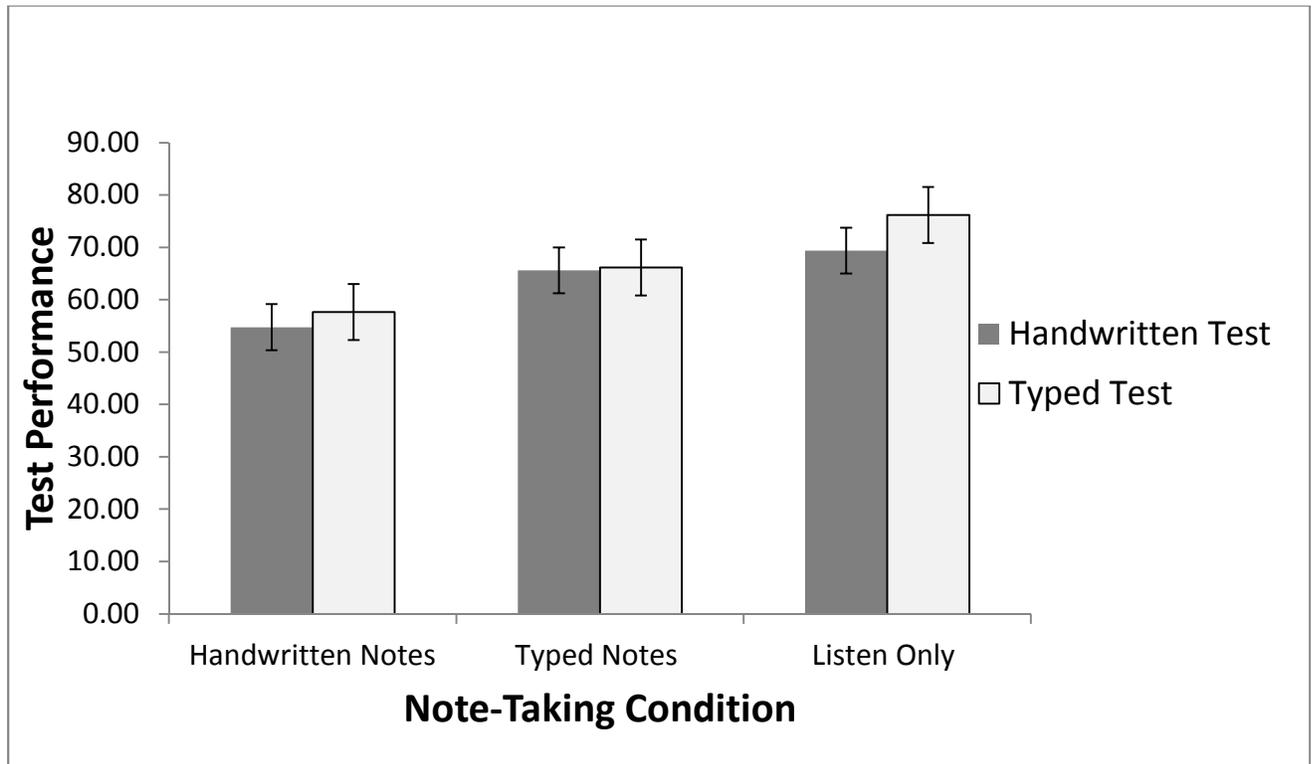


Figure 1. Overall test performance between the three note-taking conditions (handwritten, typed, listen only) and method of testing (handwritten or typed). Those that just listened to the lecture performed significantly better on overall test performance than those who wrote notes by hand. The error bars indicate the standard error of the means.

Figure 2

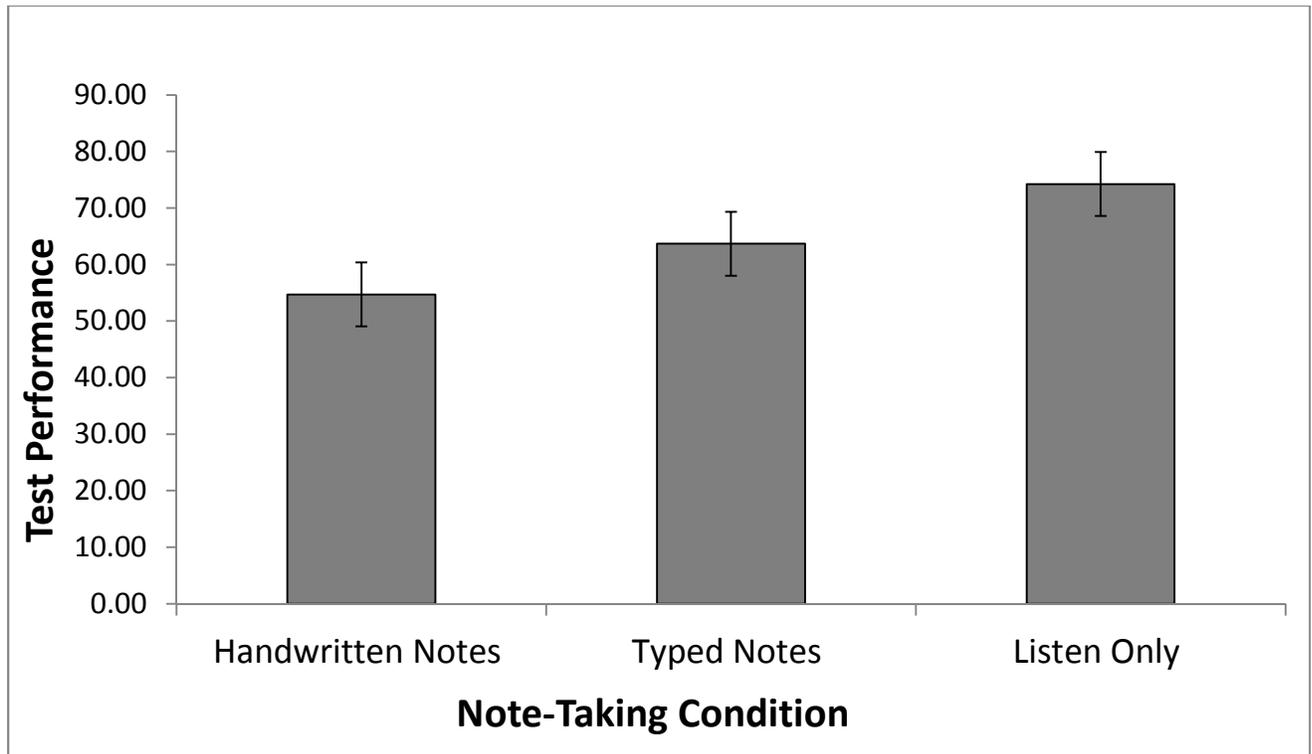


Figure 2. Application question test performance for the three different note-taking methods (handwritten, typed, listen only) collapsed across testing methods (handwritten and typed). Although these results are not significant, the trend that appears is that in the case of application style questions you do marginally better than the conditions that took notes. The error bars indicate the standard error of the means.

Appendix A

Participant #

Choice, Happiness, and Spaghetti Sauce

1. What was the name of the speaker's book he mentioned?

- a) Blink
- b) What Really Makes us Happy
- c) Choice
- d) There was no book mentioned

2. What is Psychophysics?

- a) The study of affect, behaviour, and cognition
- b) The study of the relationships between physical stimuli and mental phenomena
- c) The study of the nature and properties of matter and energy
- d) The study of living organisms

3. What is Howard Moskowitz most famous for?

- a) Contributions to Pepsi
- b) Contributions to diet Coke
- c) Contributions to Campbell Soup
- d) Contributions to Prego

4. Who was the guest speaker you watched?

- a) Howard Moskowitz
- b) Ted Pepper
- c) Malcolm Gladwell
- d) Charlie Williams

5. What is horizontal segmentation?

- a) Clusters or groups all placed on the same level
- b) Clusters or groups all placed in a hierarchy
- c) A and B
- d) None of the above

6. Which one of these types of spaghetti sauce was not mentioned in the video?

- a) Extra chunky
- b) Sweet
- c) Sour
- d) Creamy

7. What was Howard's gift to the American people?

- a) Universal principles
- b) Psychophysics
- c) Modern Medicine
- d) Variety in the food industry

8. Which is NOT one of the three groups the American people fall into with respect to tomato sauce?

- a) Extra Garlicky
- b) Plain
- c) Extra Chunky
- d) Spicy

9. How was expectation a great motivational factor for Howard? Explain and use examples from the video.

10. "To a worm in horseradish the world is horseradish". What does he mean by this statement?

Appendix B

Participant #

Note Taking Strategies in a Lecture Environment

Participant Survey

1. Age: _____
2. Gender:
 Female
 Male
 Other
3. How many years have you been at Algoma University?
 1 2 3 4 4+
4. What is your major / field of study at the present time?

5. Do you normally take notes during class?
 Yes
 No
6. **If yes**, what do you use to take notes?
 Pen and paper
 Computer
 Other _____ (e.g., phone, tablet)
7. Have you ever taken an online test for academic or professional purposes?
 Yes
 No
8. **If yes**, what is your average for computer written tests? (If you do not remember exactly, just estimate)
 50% or less
 51% - 60%
 61% - 70%
 71% - 80%
 81% - 90%

91% - 100%

9. What is your average for pen and paper written tests?

50% or less

51% - 60%

61% - 70%

71% - 80%

81% - 90%

91% - 100%