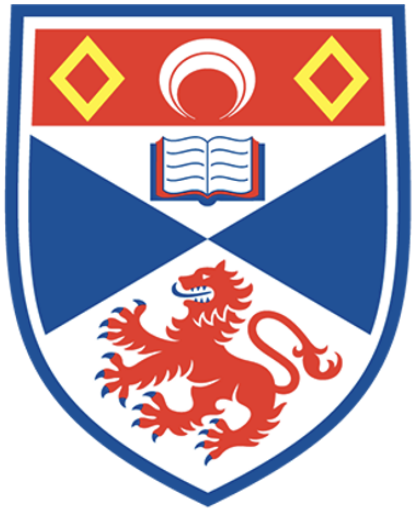
A Comparison of Note-Taking Strategies in a Blended Environment on Module Performance in Brazil



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INTRODUCTION

Note taking methods and their effectiveness

Student note-taking behavior in classroom environments has become a thoroughly researched topic in the past few years. Various investigations have been conducted with the goal of establishing which note-taking strategy is most effective for information retention and can ensure the best performance on examinations. Much of the research done relies on two explanations as to how note taking could impact exam performance: the encoding and external storage hypotheses (Mueller & Oppenheimer, 2014). "Encoding" is a term that relates to the initial process whereby externally perceived information is converted into a form that can be stored in one's brain (McLeod, 2013). Thus, as it relates to note-taking, the encoding hypothesis proposes that the way in which information is processed during encoding can influence learning and retention. The external storage hypothesis states that reviewing information present in notes can help its retention in memory (Mueller & Oppenheimer, 2014).

An interesting debate then comes to light when considering the relationships between different mediums of note-taking and these hypotheses. It is often found that students who take notes by typing on a computer are able to take more notes than those who choose to write on paper. This alone could lead to the assumption that those who take notes on a computer would perform better in examinations as they would have more information to study from and therefore would have greater benefits when it comes to external storage (Mueller & Oppenheimer, 2014). Yet, notes taken on a computer are often verbatim to what the lecturer has said, and thus involve less cognitive processing (Urry et al., 2021). The encoding hypothesis suggests, then, that due to the fact that when one is writing by hand they are forced to be more selective on what information to include in their notes, and thus engage in more complex cognitive processing, handwritten notes are more beneficial when one is not given the chance to review (Mueller & Oppenheimer, 2016). Interestingly, a 2014 study found that irregardless of review, students who took notes by hand tended to outperform their peers who took notes on a computer. It was then concluded that handwritten notes are always preferred (Mueller & Oppenheimer, 2014).

Yet, a recent replication of this study had different results. While the authors did find that laptop users' notes had more verbatim overlap with the lecturer, and that greater verbatim overlap was associated with poorer quiz performance, they found "only small, statistically nonsignificant differences in quiz performance as a function of note-taking medium" (Urry et al., 2021, 336).

These results, then, put into question the aforementioned suggestion that handwritten notes are always better when it comes to examination performance. However, this seems to be a less popular result and other studies such as that by Umejima et al. (2021) also agreed that handwritten notes lead to better information recall.

The switch to online learning

Since March 2020, education has taken a very different form worldwide. Given the present COVID-19 pandemic, higher education institutes have been forced to make a switch from the well established method of in-person teaching to a fully online approach. Online lessons often take one of two forms: synchronous (i.e. lectures are watched live) or asynchronous (i.e. lectures are recorded and watched at the student's own convenience) modes of presentation. While asynchronous modes of presentation allow for a more flexible approach to learning that is often needed and appreciated in the current times, it can exacerbate feelings of loneliness as well as decrease the interaction between students and teachers, as well as students and their peers, which can lead to decreased motivation (Harris et al., 2021). Interestingly, however, a recent study found that students who engage in synchronous learning tend to engage in distracting activities such as social media more frequently (Kim, 2021), which demonstrates a need for further investigation into online learning and its modes of presentation.

The current project

There has been little to no attention given to how note taking methods are affected by online learning, and no clear consensus exists on whether the most effective method differs from that which has been established for in-person learning. Given the already existing issues with online learning, it is of great importance that we can come to a conclusion on what method, medium and style of note taking would ensure greatest exam performance so as to help the students get the most out of this unprecedented experience. The present study aims to investigate the effect of different note taking strategies on overall module performance in Brazilian university students engaging in online learning. It also aims to investigate the relationship between mode of presentation and frequency of distracting tasks as a means to confirm the aforementioned effects.

A series of predictions are made:

1. People who take handwritten notes will perform better in their examinations than those who type their notes on a computer;
2. Students who took notes will outperform those who did not, regardless of medium used;
3. Students who took notes verbatim will have lower final grades than those who wrote in their own words;
4. Students who watch lectures mostly in a synchronous mode of presentation will tend to engage in a higher amount of distracting tasks during lectures than those who engage in asynchronous modes of presentation.

METHOD

Participants

This study used a self-selected (voluntary) sample of students at Brazilian universities. Participants who did not complete the study (N=108) as well as those who took less than 180 seconds to finish the survey (N=25) were excluded from the analyses. Two further participants were excluded as they were high school students, and a last participant was excluded as they studied at a university that was not in Brazil. The data from participants who did not consent to all of the items in the consent form was also not used in study (N=57). Thus, a total of 114 students at 34 different Brazilian universities were included in the present study. Of those, 49 participants identified as female, and 65 as male. Further, 26 participants said they studied an arts and humanities subject, 87 were science, technology, engineering, or math (STEM) students, and 1 studied other subjects. It is worth noting that not all 114 participants answered every question in the survey, thus a participant's data was only included in the relevant analyses.

Materials and procedure

A survey consisting of 36 questions was translated into Portuguese and used for data gathering. It first asked for information on the participants' demographic, and proceeded to ask questions about the mode of teaching and study habits employed by the participants for the modules in which they received their lowest and highest grade in their most recent examinations. Participants were presented with the survey on Qualtrics, an online platform. All data analysis was done using IBM SPSS statistics software.

Data analysis

A series of t-tests were performed to test the hypotheses related to style and method of note taking and how they affect the students' grades. Adjusted values were used for all t-tests to account for violations in the assumption of equality of variance. Furthermore, a chi-squared test of independence was used to analyze the frequency of distracting tasks in synchronous compared to asynchronous learning. A significance level of $\alpha = 0.05$ was used for all analyses. For the more technically-minded reader, all analyses are included in Appendices A through E.

DISCUSSION

The aims of the present study were to investigate whether different note taking strategies had an effect on overall module performance of Brazilian university students engaging in online learning, as well as to establish a relationship between mode of presentation and the frequency in which students engaged in distracting tasks. The data gathered supported some of the proposed hypotheses, although not most.

Firstly, it was predicted that students who take notes on paper would receive higher grades than those who type their notes on a computer. The results, however, do not support this hypothesis and showed no significant effect of note-taking method on both the highest and lowest grade conditions. This finding is not in line with a lot of the current literature mentioned in the introduction section of this report, although it is in line with Urry et al.'s (2021) findings. Interestingly, the previously mentioned studies by Urry et al. (2021) and Mueller & Oppenheimer (2014) both used online tools to present the participants with information, namely TED talks, and thus the present findings cannot be attributed to the fact that the participants were engaging exclusively in online learning. A conclusion is then reached that choosing a specific note taking style alone does not help students perform better in their examinations.

A second hypothesis proposed stated that taking notes would enable better module performance, regardless of medium. Interestingly, the data for the participants' highest grade did not support this hypothesis, but that for their lowest grade did. The latter finding is in line with the encoding hypotheses, as it shows that the act of taking notes has indeed helped the participants encode the information presented to them more deeply. The fact that no significant effect was found for the highest grade condition is very intriguing. A study by Eskritt & Ma

(2014) showed that the act of note taking does not help improve memory, and can in fact lead participants to intentionally forget the information they were presented as they believe they will have their notes to help them and thus do not need to memorize the information. It is difficult to know whether this effect also accounts for the present effect, and further investigation is needed to explain the disparity in the present study's findings.

Perhaps the most fascinating findings of the present study are related to the third hypothesis, which stated that students who took notes verbatim would perform more poorly in their examination than those who took notes in their own words. This prediction was made with the previously mentioned encoding hypothesis in mind, as it was believed that the extra cognitive power needed to transcribe notes in their own words would lead to deeper encoding of the information (Mueller & Oppenheimer, 2014). The present study, however, found that those who took notes in their own words tended to receive lower grades in both the highest and lowest grade conditions. Perhaps an explanation for this comes from the external storage hypothesis, and those who took notes verbatim were able to note down more information and thus had more content to review later. However, since no data was gathered on the amount of notes each student took, we cannot reach such a conclusion and further investigation is needed.

A last hypothesis proposed was that those who engage mostly in a synchronous mode of presentation would be distracted by other tasks more frequently. The data for both conditions did not support this prediction: no significant effect was found in the highest grade condition and although a significant effect was found in the lowest grade condition, it showed that students who watched lectures asynchronously were distracted more often. These findings are not in line with previous literature, namely the 2021 study by Kim. However, a 2015 study showed that student motivation and interest in a class was higher when it was watched live compared to when it was recorded (Varao-Sousa and Kingstone, 2015 as cited in Kim, 2021). Perhaps the participants of the present study were already unmotivated in their lowest grade module, and when coupled with asynchronous learning this motivation decreased even more and led them to engage in more distracting tasks. Future studies could aim to focus on this aspect specifically, taking motivation, grade, and interest level into account in order to come up with a more definite conclusion.

Limitations

The present study has a few important limitations. Firstly, the sample consisted of only 114 students, and not all of them were included in every analysis. A likely reason for this is the fact that because the study was conducted outside of the UK, we were unable to offer the participants any reward for participating, so students had little incentive to fill out the survey. Further, the majority of the participants studied STEM subjects, and all of the participants studied in Brazil. All of these aspects severely limit the generalizability of the present findings, and they mean that any conclusions cannot be taken as universal. The sample used is also unusual in that the majority of participants scored over 90% in the module where they got their highest grade, further limiting the generalizability of the findings. Next, there is a chance that the questions in the survey have been misinterpreted. Finally, there is also a chance that the participants did not remember their study habits correctly, which would have significantly affected the present results.

CONCLUSION AND RECOMMENDATIONS

The present findings lead to the conclusion that the aspect of note-taking that influences one's performance in a module the most is whether they have taken notes verbatim or in their own words. A suggestion can then be made that in online-learning scenarios, notes should be taken mostly verbatim, which can enable for thorough reviews and better overall module performance. Further, given that note taking medium does not impact performance when it comes to online learning, it is suggested that students use whichever method makes them the most comfortable. Lastly, despite the inconsistent findings it is still recommended that students take notes during their classes, especially in those that they are struggling in, as it can help them achieve better overall results. There is still a need to better understand which of the present findings can be attributed to the switch to online learning, and future studies should aim to reach such conclusions.

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APPENDICES

Appendix A - Normality assessment

A Kolmogorov-Smirnov with a Lilliefors significance correction test was used to determine normality of the participants' reported grades. The results of this analysis for the highest grade received by the participants showed that the data is not normally distributed: $D(107) = 0.283$, $p = 0.000$. The data for the lowest grade received by the participants is also not normally distributed: $D(89) = 0.186$, $p = 0.000$. Given these findings, all following parametric analyses should be treated with caution.

Appendix B - Handwritten versus typed notes

There was a non-significant main effect of note-taking medium on the highest grade achieved by the participants ($t(35.47) = -0.309$, $p = 0.379$). Thus, the medium employed for taking notes during lectures does not impact a participant's module performance when it comes to their highest grade.

Similarly, there was also a non-significant main effect of note-taking medium on the lowest grade achieved by the participants ($t(30.29) = 1.171$, $p = 0.126$) Thus, the medium employed for taking notes during lectures also did not impact a participant's module performance for the module in which they received their lowest grade.

	Keyboard			**Pen & paper**		
	N	**Mean**	**St. dev.**	**N**	**Mean**	**St. dev.**
Highest final grade	23	94.61	9.967	59	95.34	8.594
Lowest final grade	14	74	12.564	47	69.02	17.872

Table 1. Mean and standard deviation for the final grades achieved in the first semester of 2021 based on the note-taking medium used

Appendix C - Notes versus no notes

There was a non-significant main effect of taking notes on the highest grade achieved by the participants ($t(29.73) = 0.200$, $p = 0.422$). Thus, the act of taking notes during a lesson did not impact a participant's module performance when it came to their highest grade.

Contrarily, there was a significant main effect of taking notes on the lowest grade achieved by the participants ($t(28.61) = 2.029$, $p = 0.026$), with those who took notes achieving overall higher grades (mean=70.40) than those who did not (mean=58.22). Thus, the act of taking notes during a lesson impacts a participant's module performance when it comes to their lowest grade.

	Notes			**No Notes**		
	N	**Mean**	**St. dev.**	**N**	**Mean**	**St. dev.**
Highest final grade	84	95.13	8.846	17	94.76	6.437
Lowest final grade	62	70.40	16.806	23	58.22	26.919

Table 2. Mean and standard deviation for the final grades achieved in the first semester of 2021 based on whether or not the participants took notes

Appendix D - Verbatim notes versus own words

There was a significant main effect of note-taking style on the highest grade achieved by the participants ($t(54.59) = 3.456$, $p = 0.001$), with those who took notes in their own words achieving overall lower grades (mean=92.73) than those who wrote what the lecturer said verbatim (mean=98.40). Thus, the style employed for taking notes during a lesson does impact a participant's module performance when it comes to their highest grade.

Similarly, there was a significant main effect of note-taking style on the lowest grade achieved by the participants ($t(54.86) = 2.300$, $p = 0.013$)), with those who took notes in their own words achieving overall lower grades (mean=66.31) than those who wrote what the lecturer said verbatim (mean=75.56). Thus, the style employed for taking notes during a lesson also impacts a participant's module performance when it comes to their lowest grade.

	Verbatim			**Own words**		
	N	**Mean**	**St. dev.**	**N**	**Mean**	**St. dev.**
Highest final grade	30	98.40	2.500	48	92.73	10.921
Lowest final grade	25	75.56	12.884	32	66.31	17.455

Table 3. Mean and standard deviation for the final grades achieved in the first semester of 2021 based on the note-taking style

Appendix E - Frequency of distraction by mode of presentation

There was a nonsignificant association between the mode of presentation used to watch lectures and the frequency in which participants avoided distracting tasks in the modules where participants achieved their highest grade ($\chi^2(8) = 4.126$, $p = 0.846$). Thus, mode of presentation did not affect frequency of distractions in the highest grade condition.

There was a significant association between the mode of presentation used to watch lectures and the frequency in which participants avoided distracting tasks in the modules where participants achieved their lowest grade ($\chi^2(8) = 27.526$, $p = 0.001$). Those who participated in synchronous learning tended to avoid such tasks more often than those who used an asynchronous mode of presentation. Thus, mode of presentation did affect frequency of distractions in the modules where students' received their lowest score.

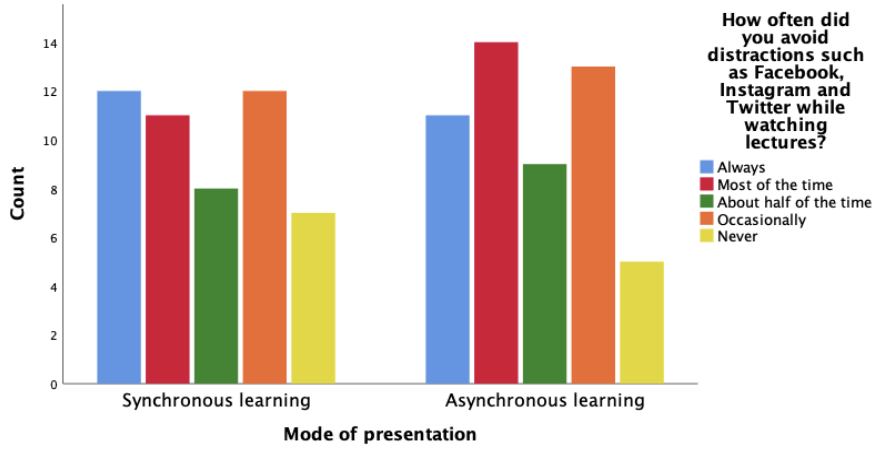

Figure 1. Bar chart of mode of presentation by frequency of distractions for highest grade

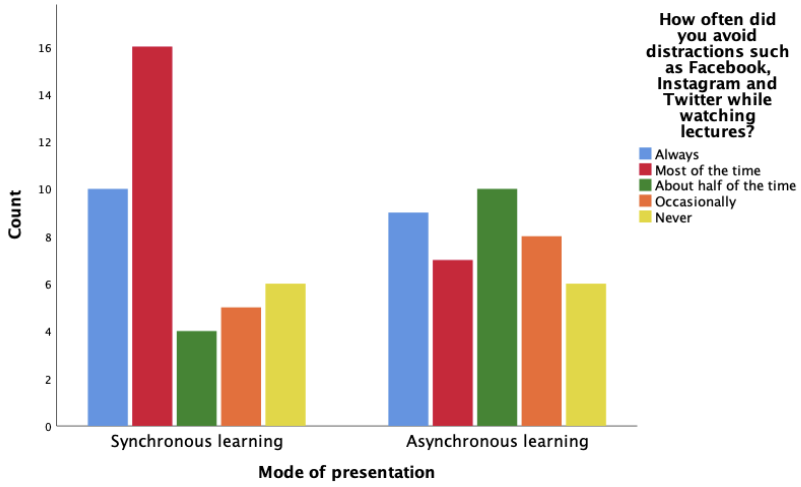

Figure 2. Bar chart of mode of presentation by frequency of distractions for lowest grade