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High School Student Responses to the Use of Laptops in Class

AP Research

Word Count: 4694

## Introduction

The use of technology in education is something that has always been present to prepare students for the workplaces they will go into after graduation. For the past two decades, laptops and tablets have been implemented into K-12 classrooms as well as in classes at places of higher education. Because of the widespread implementation of these technologies, it is of the utmost importance to ensure they are having a positive effect on the students using them.

Many studies have been done on the effectiveness of notetaking in college lectures with laptops as well as the affect laptops have on a class environment in colleges. The majority of these studies focus on the academic difference and memorization skills of the students when using laptops to take notes in class compared to notetaking with paper. Few of these studies follow up with students on their experience with using technology in class. Of the minority of studies done with students in K-12 most of which did the studies on middle-schooler (Age 11-14), additionally, these studies had small sample sizes. Additionally, the majority focused on the academic achievement when using laptops in class compared to paper to take notes. In addition to the majority that focused on note taking, some studies focus on the use of laptops to access online labs and educational software.

This study will add to the existing academic literature by conducting a survey of high-school students (age 14-16, Grade 9-10) to ask about their experience with using laptops in class, specifically: are they used for notetaking, are they used for educational software, how engaged the students are when using compared to when not using laptops, how distracted students are when using laptops compared to not using them, what the effect on class environment is and what the students' preference is. This will fill the gap in research on

high-school aged students as well as on the students perspective, which is nearly absent from the academic discussion.

### **Literature Review**

To ensure the academic research is the most reliable today, This study aimed to only compare to research done since 2006 where modern, internet capable laptops and programs could be widely used by students. From the literature on laptop use in classrooms, one aspect of research is on the effect of multitasking on students.

In one study administered by Dr. Sana, Dr. Cepeda, Dr. Wiseheart, and Weston from York University's department of Psychology, not only did participants who multitasked during the lecture ( $M = 0.55$ ,  $SD = 0.11$ ,  $n = 20$ ) score significantly lower than participants who did not multitask ( $M = 0.66$ ,  $SD = 0.12$ ,  $n = 20$ ), participants in view of multitasking peers also scored significantly lower on the test ( $M = 0.56$ ,  $SD = 0.12$ ,  $n = 19$ ) than participants not in view of multitasking peers ( $M = 0.73$ ,  $SD = 0.12$ ,  $n = 19$ ) (Sana et al., 2012). Not only did students who saw others' screens do worse on tests than those not seeing others' screens, they did worse than those who were not even multitasking, showing how detrimental screens can be to not just the students using the computers, but to all those around them. These results carry significance as not only were the levels of significance (Experiment 1 had a significance of  $F(1,38) = 10.2$ ,  $p = .003$ ,  $\omega^2 = .20$  and experiment 2 had a significance of  $F(1,36) = 21.5$ ,  $p < .001$ ,  $\omega^2 = .36$ ) these results were also consistent with Barak et al., (2006); Hembrooke & Gay, (2003); Kraushaar & Novak, (2010); and Wood et al. (2012) (Sana et al., 2012). These papers were all confirmed by Sana et al.'s research and such this paper focused on the research done by Sana et al. because it includes that of other previous studies. Another aspect of this study was the student responses

after the experiment, where responses from Experiment 1 show that participants in the multitasking condition were aware that multitasking during the lecture would “somewhat hinder” their learning ( $M = 5.5$ ,  $SD = 2.0$ ) (Sana et al., 2006). However, they estimated peers’ learning would be “barely hindered” ( $M = 3.3$ ,  $SD = 1.9$ ). Additionally, responses from Experiment 2 suggest that participants reported being “somewhat distracted” by nearby confederates ( $M = 3.3$ ,  $SD = 2.1$ ). As well as that those in view of a multitasking peer “barely” hindered their own learning ( $M = 2.7$ ;  $SD = 1.6$ ) (Sana et al., 2006). Because students do not believe that their detrimental behavior is significant, they can pose harm to the academic environment of their peers, and hinder a lesson’s effectiveness if not addressed properly by the teacher or professor.

Other studies have used post experiment surveys, such as a survey done by intermediate educator Jason O. Hulst. In this study, all achievement levels; high achievement, median achievement, and low achievement, scored better on tests where they used online labs and lessons to learn the material than when using traditional methods of simply learning through note taking during lecture (LALG  $n=17$  from 3.89% to 5.82% improvement with a normalized gain from .108 to .212; MALG  $n=12$  from 3.50% to 5.50% improvement with a normalized gain from .130 to .247; HALG  $n=14$  from 2.57% to 4.00% improvement with a normalized gain from .211 to .335) (Hulst, 2015). These findings strongly suggest that the students using interactive educational software in class on their laptops learned more than when the students were just learning through lectures and worksheets. Each group; low achievement learning (LALG), median achievement learning (MALG), and high achievement learning (HALG), all significantly improved their understanding when using laptops compared to their control lesson. Hult’s survey then found that students were more interested in topics when using online educational software

compared to when lecturing traditionally from textbooks seeing an increase in the median from likert scale results (Hults, 2015). The study had practically significant results from students survey in addition to the practically significant results from student grade improvements. In one large scale study done by Christopher R. Poirier at Stonehill College and Robert S. Feldman at University of Massachusetts, Amherst studying the effectiveness of individual response technologies (IRTs) found that students in the IRT course performed significantly better ( $M = 84.03\%$ ,  $SD = 7.54$ ) than when the students were observed in a control environment without the presence of laptops ( $M = 82.72\%$ ,  $SD = 7.64$ ),  $t(863) = 2.54$ ,  $p = .01$ , Cohen's  $d = 0.17$ ) (Poirier and Feldman, 2007). In addition to student doing better in class, Over 66% of students believed that they learned more during class because IRT allowed them to apply what the professor taught (Poirier and Feldman, 2007). In addition, 67% of students agreed that IRT encouraged them to talk to other students, and over 70% of students thought that IRT was fun and made the class more enjoyable. The results were both practically and statistically significant in findings which are supported by the results found by Jason Hults' study (Poirier and Feldman, 2007). However, the feedback regarding the use of IRT was not consistently positive. Although students reported learning more during class because of IRT, nearly half of the students reported that IRT did not significantly improve their classroom learning (Poirier and Feldman, 2007).

To directly see the difference between the use of laptop notebooks for note taking and paper, Duran and Frederick conducted a case study in which they found a significant difference between comprehension test scores for those in the paper note-taking condition and those in the laptop note-taking condition where the paper note-taking condition scored practically significantly higher than those in the laptop condition ( $U = 889.0$ ;  $p = .006$ ) (Duran, Frederick,

2013). Another study which studied deeper memorization found consistent results on two types of tests, a recognition and a recall, this study performed by Smoker, Murphy, and Rockwell at UCF found Memory on the recall task approached significance for handwritten words, ( $F(1, 59) = 3.34, p = .065$ ); and was significant on the recognition task, ( $F(1, 59) = 4.63, p = .036$ ) (Smoker, Murphy, Rockwell, 2009). The number of errors in the recall task was significantly higher for the typing condition,  $F(1, 59) = 4.803, p = .032$ . The number of errors for the recognition task was not significant (Smoker, Murphy, Rockwell, 2009). These findings suggested that notetaking in class is hindered when using a laptop compared to when using handwriting. In addition to looking at note taking using laptop notebooks, a study can look at the effectiveness of only using educational software to aid with instructional materials. One such study by Aberšek, Aberšek, and Flogie found when writing essays the quality was significantly better in the writing group compared to the typing group across many aspects: lexical levels, syntax levels, text coherence, cohesion, and semantic levels (Aberšek, Aberšek, and Flogie, 2018). These results are similar to the quality of note taking shown by Smoker et al. showing that the use of laptops in uses other than educational software and programmes in class could be a hindrance to class environment as well as to student academic achievements.

In a review by the Texas Center for Educational Research on K-12 districts that implemented laptop programs, they found that there was a small benefit in high achieving students, but the overall difference in grade pre to post trial was negligible because of this negligible improvement at best in students, some schools that had implemented technology programs were backing out of them to save money, (e.g. Matoaca High School just outside Richmond, Va., the Liverpool Central School District, just outside Syracuse, Everett A. Rea

Elementary School in Costa Mesa, Calif., Mount Hermon School, etc.) (Hu, 2007). The mixed results of one to one computer programmes brings attention to the possibility for harm to be caused from the implementation of these programmes. One flaw in this study is that it is over a decade old, and as such the information on modern technology is not completely applicable to today. Despite these concerns many more schools are implementing one to one computer programmes making it necessary to understand the effect one to one laptop programmes will have on students.

While studies have been done showing a positive trend when implementing laptops in class environments in university and middle/intermediate school settings, there is insufficient amount of current literature on secondary level education environment. Thus this study will focus on the gap in academic literature around laptops in high/secondary schools, and specifically focusing on comparing these findings to those of papers using post-test surveys.

### **Question**

Are High School Student Responses to the Use of laptops in Class Consistent with that of College Students and Middle School Students. How do students who use laptops to take notes compared to using laptops to use educational software, between students in different level classes i.e. AP, Honours, and CP students, and students in different grade levels' responses compare.

### **Hypothesis**

Students who use laptops to access educational software will feel like their laptops make them more engaged in class but that their studying is less improved than the students who take notes using their laptops. This would support the current consensus of the current academic

material. laptops will have the same effect on students in different level classes, but higher achievement levels will find a bigger benefit in using the laptops in classrooms.

### **Methods**

During the search for academic literature, the researcher used Google Scholar, EBSCOhost, JSTOR, and ERIC.gov to find existing literature. On each site, search terms such as “laptops in classroom”, “laptop note taking”, “educational technology”, and “Student response to technology” were used to find literature. The search process involved using multiple strings and saving scholarly work that matched what the research was searching for, then after reading the sources they found, going into the bibliography of articles and selecting papers that could be used to advance research further based on what information was used in the previous papers the researcher read and finding more useful data to further what they had found for a better comparison later in this paper.

After the researcher had found sufficient existing literature, they chose to focus on comparing findings of post-test surveys as it would create the best comparison to previous research without needing to gather sensitive information. As such, the researcher conducted a survey at Thousand Oaks High School in Thousand Oaks, California replicating the questions in previous post-test surveys. The survey consisted of 16 question, 5 general boolean scale questions and 11 five-point likert scale questions (making the survey take roughly 3 minutes to take), all of which were based on those used in previous surveys of university students, and middle school students alike in order to create the best comparison possible. Subject will be selected by having some 9th and 10th grade general education teachers of the 3rd period distribute the survey to the students after a brief talk on what the survey covers. By having the



survey distributed during only the third period, it ensures that there are no duplicate responses. The number of subjects depends on how many classes, and with 4 classes being selected the survey would most likely have 60-100 students take it depending on how many students chose to opt out. The survey is entirely anonymous and do not ask for any personal information either. Of course the survey will be entirely voluntary as well to ensure it passes ethical guidelines on surveys set by the Conejo Unified School District which Thousand Oaks High School is in. This sample size is around 6% of the population of 9th and 10th grade students at the school making it statistically significant. The method of subject recruitment will be by selecting the student of each participating teacher, and the teacher will distribute the surveys to all the students who agree to participate. This paper excluded students that are not in 9th grade or 10th grade, AP, honors, or college prep for consistency with other studies on general education students. All student information will be confidential as the online survey is anonymous and does not ask for any personal information beyond grade level, as well as excludes questions on respondent's sex, ethnicity, and socioeconomic factors to maintain anonymity as well as to ensure the efficacy of the study.

The data from the survey is comprised of interval, ordinal and nominal data which The researcher used to find the trends from the sample data mostly comprised of 2 variable comparisons which will be used to compare to existing literature to draw a conclusion on whether or not the results with high school students is consistent with studies done on university students. When analysing data from likert scale questions the researcher took the percentage of respondents that agreed/disagreed to the question as a metric to compare different populations so that the most usable information could be gathered from the data. This is a replication of the

same methods done in the studies being compared to, so it will allow for the most thorough analysis. Since likert scale data is ordinal no mean can be found, and if no difference can be shown in the median or mode then the method will most clearly show the trends in the impartiality and ethical way. When finding the significance of the findings this paper used the Mann Whitney U test, Spearman's Rho test, Chi Squared test, and simple T-tests in order to find the significance values of the results gathered.

### **Results**

The survey compiled (n=76), in which found that students, based off their responses, studied better with laptops ( $p < .01$ ), found class more interesting while using their laptops ( $p < .01$ ), , found class more enjoyable while using their laptops( $p < .01$ ), and were more engaged in class when using laptops ( $p < .01$ ). These results are consistent with those from Hult and Feldman and greatly demonstrate the positive benefit laptops can have in classes. Additionally, the majority of the sample used laptops in class for majority educational software and not for note taking (n=43). There is not a practically significant difference between the sample of students who use laptops in class for note-taking compared to students who use laptops in class for educational software in their engagement in class. Suggesting that the findings by Hult and Feldman of students being less distracted over time is apparent in high school classes as well. Furthermore, the comparison of high achievement learning group (HALG), medium achievement learning group (MALG), and a low achievement learning group (LALG) was not possible. Despite trying to data findings to compare to those of Hults to see if there is a consistent consensus, the vast majority of subjects from the survey were in the LALG so comparing the results of different groups to the previous study would not give any statistically

significant results as there was too small of a sample size for both the HALG and MALG. There were not enough students in the HALG and MALG to statistically significantly confirm any previous results, and is the major limiting factor in this paper's data analysis.

Additionally, when looking at trends between groups, no practically significant findings of students enjoying class more or less when using laptop notebooks in class compared to traditional pen/pencil and paper methods could be found. Additionally the consensus from the survey was about even about being distracted when using laptops in class. Furthering this, the majority of survey sample believed they were not distracted more when those around them were on laptops and that those around them were not distracted when they were using laptops in class which is consistent with which stated that despite students believing they were not distracted and their classmates were not distracted, the students performed significantly worse than the control group. Furthermore, the majority of students preferred to study using their laptops (n=56), but the majority preferred to take notes using pen/pencil and paper (n=42). Outside of school, the majority of students used their laptops to work on homework and projects, turn in assignments online, and use educational software/programs and online study resources (n=64, n=57, and n=44 respectively) while 36.8% of students also used their laptops to review notes (n=28) of these 28 surveyed, a slight majority of 15 used their laptops to take notes meaning how one takes notes in class is not a practically significant factor in determining if one were to review their notes at home using their laptop. These results are consistent with those done previously in both the university and middle school levels. From this it is safe to conclude that there is a similar cause behind the results to that found in the previous studies this paper is comparing to. This would mean that students get more distracted when using laptops without a specific purpose in class

causing disruption to the class environment as a whole. Despite this, when using laptops for specific tools the instructor wants the students to use, it can have the opposite effect increasing attentiveness of students due to lectures becoming more interactive and engaging such as when using IRT's in programs such as Kahoot™, observed to be used in high schools, or when using education software such as virtual labs in science classes allowing for better visual aids and self learning to the students on a particular topic, this is the same result that Poirier and Feldman found in their study of university large lecture classrooms.

Teachers can apply this by actively incorporating laptops into their classrooms and integrating them into their lessons so that they can utilize the technology properly without harming the class environment. This can be further seen from how the majority of students prefer to study using online materials and programs accessed with their laptops, but at the same time prefer to take notes with pen and paper. Showing how students can tell that laptop note taking can be ineffective as show in the findings of Sana et al.'s research. Furthermore, just as Sana et al. found that students thought they were not distracted by laptops, the survey found that students did not think they or their classmates around them were distracted when someone, whether them or someone else, was on their laptops. Furthermore, Sana er al. and Smoker et al. found despite this, students both when on and those around them were on their computers performed significantly worse on performance evaluations when compared to when not using laptops. Coming back to the students preferring pen and paper note taking to laptop note taking furthers this, allowing the conclusion that students might subconsciously know that the computers distract them, but they do not notice it enough to say in their responses.

Of the 76 respondents only 9% (n=7) did not use their laptops in one form or another for educational purposes outside of school as well showing how valuable the programme is not only for students in class, but also for students to easily review what they learned out of class. While this is a significant proportion of the population, the fact that over 90% of students using laptops outside of school shows the positive impact of the program. Of these students 81% (n=56 of 69) use their chromebooks weekly, 25 of which use it every day, and of the total sample, 74% (n=56 of 76) use their laptops weekly. Students who use laptops for educational software find class more enjoyable when using laptops in class 10% difference, use them less (which is to be expected) 20% difference, there was no practical significance in how distracted each group was when on laptops both around 30%. Five percent more students in the laptop note group studied better with their chromebooks, can be explained as the students with digital notes may find it slightly easier to review material. Students finding class more interesting when using laptops for educational software is consistent with previous studies. An interesting note is how students who use laptops for educational software use laptops less in classrooms, but can be explained as the group which took notes using laptops more often were allowed or instructed to use their notebook computers by their teacher. Additionally, the lack of difference in students admitting to being distracted in each group signifies that using laptops for different functions, or period of time, does not affect the likelihood a student will go off task with their computers. Additionally, because more students who use laptops for notes found that their computers improved their studying, the survey came back supporting the alternative hypothesis, and furthermore supporting the current consensus by existing literature in the field.

Between grade levels, there was no practical difference between the groups when asking how laptops affect student's interest in classes, but the 10th grade class had 10% more students that responded they were more engaged in class when using laptops compared to the 9th graders' responses, and even more greatly, when asked how much more the chromebooks distracted the students, 48% of Freshmen believed the laptops made them more distracted while only 4% of Sophomores were more distracted when using a laptop in class. Despite this, when asked if using laptop distracted those around them, or if classmates on laptops distracted them both groups believed they were not negatively affected by the use of laptops. Distracted when those around you are on laptops: 10th grade =33%, 9th grade = 23%; Those around you are distracted when you are on a laptop: 10th grade =4%,9th grade =12%. These results are consistent with those in previous studies where in surveys subjects do not notice the negative affect laptops have on the class environment, nor the negative effect they can have on student performance, but there still is a significant amount of disruption and negative influence on grades caused by the presence of laptops in classes. Even though in Sana et al. the students believed that they and their classmates would not be affected by the use of laptops in class, but the groups who did use laptops did significantly worse on tests than the group without them. Furthermore, even the students who did not use laptops, but had people around them on laptops performed significantly worse than their peers in the control group. These results being consistent with the data the researcher gathered suggests that a similar trend is occurring where students are getting distracted in class from the use of improper laptop usages. Improper use cases are the use of laptops for non-instruction-related activities including: engaging in social networking, reading emails/messages, playing games, and streaming videos and music. If a school wants to

implement a paper free programme where all notes with have to be taken on laptops, an effective way to prevent these actions, other than simply blocking websites, would have to be implemented. The difference between the 9th and 10th grader's responses can be attributed to the fact that the 10th grade class has used laptops for a full year more and so they are more accustomed to their presence and are less affected by them and less likely to get distracted by their use whether by themselves, or the students around them. Additionally when looking at student engagement, many more of the 9th grade respondents felt the laptops made them less engaged in class which comes from the group which found that they were more distracted when they, or those around them were using their laptops. A follow up study should be conducted where students who were not experienced with laptops in class were studied to see the results on their performance in class to students who are experienced using laptops in class to see if there is a correlation or if the results are skewed from a number of reasons, e.g. small sample size, non-representative sample of population, lack of randomness in survey collection and analysis, etc..

### **Conclusion**

The results from my survey were consistent with the results from existing literature in both university and middle school settings. Furthermore, the expected trends that were seen by Poirier et al. as well as Hulst were duplicated in this study's findings suggesting the trends found in middle school and university settings are consistent with high school settings.

The main limiting factors in my research were that, First, my survey was only on one school, a middle class suburban high school, and might not have had an accurate representation of the entire population of high school students. A future study looking further into high school/

secondary usage of individual technology in classes should have surveys done in different socioeconomic areas to compare results. Secondly another limitation was on the number of responses the survey had this limited me vastly as this paper could not replicate the findings of Hults' research due to the lack of students and student diversity in this study. The survey responses were comprised of 76 of the 1154 students in the 9th and 10th grades at Thousand Oaks High School that were within the earlier discussed parameters to respond. This was 6.59% of the population, so it was still a statistically significant. The final limitation of this study was on the number of questions in the survey conducted, this research was advised by a mentor to reduce the survey length from around 26 to 16 questions, this limited the number of comparisons this research could make between factors as well as the research this paper could replicate ultimately leading me to only primarily compare to a handful of studies. This was done for two reasons, to maintain ethical standards in this paper's survey, as well as to shorten the time it would take to complete in hopes of increasing the number of respondents. Furthermore as one of the researcher's mentors advised, further research can be done with "pencil technology so students can still hand write their notes but in a convenient, cloud-based, environmentally-friendly way" which would better help students in subjects such as English and math.

With these findings teachers at Thousand Oaks High School can better implements laptops usage into their classes, this will be important for the 11th and 12th grade teachers who in the next two years, all of their students will have chromebooks through the one to one programme, these teachers are unfamiliar in how to teach in a technology based classroom can better be prepared for the years ahead with the help of the information found in this research.



**Appendix 1 - Survey**

# Chromebook Survey

Thank you for participating

\* Required

Grade \*

9th

10th

How many of each type of class are you taking? \*

0

1

2

3

4

5

6

7

AP Classes

Honor Classes

CP Classes

You find class more interesting when using a Chromebook \*

Strongly agree

Agree

Neither Agree nor Disagree

Disagree

Strongly disagree

Do you use your Chromebook for taking notes or for using educational programs/websites in class? \*

Taking Notes Only

1

2

3

4

5

Using Educational Programs Only

Using Chromebooks is fun and makes class more enjoyable \*

Strongly Agree

Agree

Neither Agree nor Disagree

Disagree

Strongly Disagree

Using a Chromebook in class encourages you to interact with other students \*

Strongly Agree

Agree

Neither Agree nor Disagree

Disagree

Strongly Disagree

You are more engaged in class when using a Chromebook than pen and paper

\*

Strongly Agree

Agree

Neither Agree nor Disagree

Disagree

Strongly Disagree

You are more easily distracted when using your Chromebook \*

Strongly Agree

Agree

Neither Agree nor Disagree

Disagree

Strongly Disagree

You are more easily distracted when people around you are on their Chromebooks \*

Strongly Agree

Agree

Neither Agree nor Disagree

Disagree

Strongly Disagree

Using your Chromebook distracts those around you \*

Strongly Agree

Agree

Neither Agree nor Disagree

Disagree

Strongly Disagree

Your Chromebook makes it easier to study material \*

Strongly Agree

Agree

Neither Agree nor Disagree

Disagree

Strongly Disagree

How often do you use your Chromebook outside of school for homework/studying? \*

Everyday

1-3 times a week

1-3 times a month

Less than once a Month

Never

What do you use your Chromebook for outside of school? \*

Reviewing Notes

Online Study Resources (Quizlet, Khan Academy, etc.)

Working on Homework/Projects

Turning in Assignments

Other:

Do you study more effectively when studying with or without your Chromebook? \*

With my Chromebook

Without my Chromebook

Do you prefer pen and paper or Chromebook note taking? \*

Pen and Paper

Chromebook

Chromebooks do not significantly improve your learning in class \*

Strongly Agree

Agree

Neither Agree nor Disagree

Disagree

Strongly Disagree

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