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2019-2020

Project Title: The effect of the presence of a smartphone and smartphone usage on concentration levels and academic performance in high school students.

Rationale:

In the past decade, smartphones have become almost ubiquitous. In 2019, 96% of Americans owned a smartphone compared to just 35% in 2011 (Pew Research, 2019). Americans confess to having become more and more dependent upon smartphones. Of current smartphone users, 91% say that they will not leave the house without their phone and many students admit to using their smartphones during the school day (Pew Research, 2019). Attempts to regulate smartphone usage in schools has mostly failed. In 2015, a ban on smartphone usage in schools in New York was lifted as parents expressed concerns about being in contact with their children during the school day. California has recently passed legislation that allows school districts to restrict or prohibit device use in class; although the decision as to whether to regulate Smartphone use is up to each district. California is the only state in the United States that has some type of regulation in place (Lardieri, 2019).

Smartphone overuse is not a uniquely American problem. According to the Ministry of Science and Information and Communications Technology (MSIT), more than 98% of South Korean teens used smartphones in 2018, and many showed signs of addiction. In 2018, approximately 30% of South Korean children aged 10 to 19 were classed as "overdependent" on their phones, and middle school and high school students were who extremely addicted were admitted to government-run detox camps. Similarly, in 2018, concerns of overuse led France to ban the use of smartphones for students in schools through ninth grade. France enforced this ban with the hope that school children would pay more attention in class and interact more (Rubin & Peltier, 2018). Under France's law, students were able to bring their smartphones to school but must store them in their lockers or bags during the school day. Smartphones were confiscated if students were caught using them in school. South Korea and France are rare examples though; Denmark is examining a possible similar approach but has not crafted legislation thus far

(Ritzau, 2019). In Britain, schools create policies regarding smartphones for themselves but there is no nationwide legislation that exists at this time (Wright, 2018).

Several studies have explored how smartphone use affects concentration levels and academic performance. For example, Duke, Gneezy & Bos (2017) found that when solving matrices, participants on average completed 8.3 out of 10 correctly when the smartphone was in another room but completely only 7.8 correctly when the smartphone was near them on their desk. Participants whose phone was on their desk (high salience) displayed the lowest available cognitive capacity whereas those whose phone was in another room (low salience) displayed the highest available cognitive capacity. In addition, Kuznekoff & Titsworth (2013) found that students who did not have access to their mobile phones wrote down 62% more information in their notes, took more detailed notes, were able to recall more detailed information from the lecture, and scored a full letter grade and a half higher on a multiple choice test than those students who actively used their mobile phones. Lepp, Barkley & Karpinski (2015) also found that grade point average and overall smartphone use (not specifically in classrooms)were found to have a significant negative correlation in college students. However, Kuznekoff & Titsworth (2013) tested their hypothesis in a controlled setting and therefore the results may not reflect actual behavior in a classroom. Similarly, Lepp, Barkley & Karpinski (2015) examined smartphone usage out of class and did not directly measure the effect of students' proximity to their smartphone in class had on their academic performance.

Not all studies report negative correlations between smartphone use and academics though. Kelly (2017) reported that 94% of participants who responded to their survey used smartphones in the classroom for academic purposes. 75% of participants believed personal devices in the classroom improved their ability to learn and retain information, 58% used their phones to take pictures of lecture slides, 41% used Google answers for help with in-class questions, and 39% liked having access a digital textbook.

Therefore, there is conflicting evidence as to whether or not smartphone usage positively or negatively impacts students' concentration levels and learning. While research has been conducted related to smartphone use in the past, there is little to no data available on the impact of smartphone usage in the classroom on high school students.

Question or Problem:

How do the effect of the presence of a smartphone and smartphone usage impact concentration levels and academic performance in high school students?

Hypothesis:

The presence of a smartphone will decrease concentration levels and increased smartphone usage will decrease academic performance.

Participants/recruitment:

Fifteen science teachers from a suburban high school in New York, USA, will be asked to participate in the study. The supervisor of the high school science department will send consent forms electronically to all parents of students in the classes of those teachers. Students have to electronically give their own consent before they could begin the survey as well. Hard copies of the signed informed consent forms were kept locked in the classroom as well.

Methods/informed consent process:

Survey

Survey Construction

A survey consisting of fourteen questions will be created using google forms. Questions will be categorized according to two criteria: quantification of smartphone usage and self-reported effects of smartphone usage on concentration and academic performance. Participants will be asked to self-report their smartage usage by accessing the "settings" application on their smartphone and communicate the number of hours they spent on their smartphone per day for the past week. Participants will be asked to delineate how they use their smartphone (i.e. describe your style of text messaging, opinions on the impact of their smartphone on their academic performance, the impact of smartphones on understanding of class material, etc…)

Concentration Tests

Selection of Concentration Tests

Two sets of concentration sets will be selected. Both sets of concentration tests consist of a connect the dots exercise and two letter cancellation exercises. The tests will be exactly the same; however, the order of dots will differ in the connect the dots exercise and in the letter cancellation students will be asked to find different combinations of letters. The same number of targets will be present in each test. These tests will be designed so as to have as little cultural or intellectual bias as possible. In other words, all participants will be equally able to complete them.

Concentration test protocol

When participants will arrive for testing, they will surrender their smartphones to the study administrators. The first set of concentration tests, consisting of the connect the dot exercise and the two letter cancellation tests, will be distributed. Participants will be instructed to work as quickly as possible and not to erase mistakes. At the conclusion of the first set of tests, participants will be handed their smartphones. Participants will be able to complete the second set of concentration tests with their smartphones in close proximity. Participants will be again asked to work as quickly as possible and not erase mistakes. Participants will complete the second set of concentration tests, consisting of a connect the dots exercise and two letter cancellation tests. All sets of concentration tests were consistent in length (number of targets) and difficulty.

Academic Performance

Academic performance protocol

The participants' teachers in their science classes will be informed of which students will agree to participate in the study. Teachers will observe participants' in class smartphone usage for on unit. At the end of the unit, teachers will be asked to rate each participant's smartphone on a likert. The scale will be provided with guidance on how to appropriately rate the students. A rating of one would indicate that the student did not have their phone in eyesight during class and

never accessed it during class. Conversely, a rating of ten would indicate that the student was an avid smartphone users during class. A rating of five would indicate that the student occasionally access their phone and had it in sight. A detailed scale will be given to teachers prior to the start of the study. The participants will take their unit test. The study will have no relation to the students' preparation for their exams and performance on the day of the test. The study will be in no way a disruption to teaching and learning in the classroom.

The teachers will grade all participants' tests as usual and then will randomly assigned numbers to the participants in the study . The students will be randomly numbered in order to maintain confidentiality and privacy. At the end of the unit, teachers will report the student's test score compared to the average class score. The teachers will then provide the participants test scores and smartphone usage rating.

Risk Assessment:

No risk will be present in this study.

Protection of Privacy:

Participants' responses were kept anonymous. Students will be assigned a number at the beginning of the study to maintain their privacy. Confidentiality will be maintained as solely their random number assignment and their test scores in conjunction with their smartphone rating will be reported and used as data.

Data Analysis:

Survey data analysis

De-identified survey data will be collected from Google Forms. Names and email addresses will not be included in participant responses. Data will be analyzed using pie charts and statistical significance will be determined using a z- test.

Concentration data analysis

Performance efficiency will be calculated to determine if smartphone location will affect concentration levels. Performance efficiency without a smartphone present will be compared to

the performance efficiency of participants when the smartphone was present. Performance efficiency will be calculated using the index developed by Geldmacher (1998). Higher scores will reflect more efficient performance: performance = (correct responses/total targets) × (correct responses/total time). A paired, two-sample t-test will be used to statistically determine if there will be a significant difference between the two groups. The one-tailed t-test value will be selected because the change in concentration levels will only be tested in one direction.

Academic data analysis

An ANOVA for regression test will be used to determine if there was a trend or correlation between the use of a smartphone in class and academic performance.

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