Journal of Fundamentals of Mental Health

Mashhad University of Medical Sciences

Psychiatry and Behavioral Sciences Research Center

Original Article

Investigating the effect of mobile phone use on students' attention span and academic performance

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Abstract

Introduction: In this study, we aimed to investigate the impact of mobile phone use on high school students' attention spans and academic performance.

Materials and Methods: In this causal-comparative study, 120 students of art high schools in Darmian city-Iran, were selected using purposive sampling. They fulfilled the mobile phone addiction questionnaire, a computerized Stroop test, and academic performance test. Data were analyzed using the descriptive statistics, and one-way analysis of variance.

Results: The findings indicated a significant relationship between mobile phone use and attention, and academic performance ($P< 0.05$). Specifically, increasing students' mobile phone use correlated with decreased attention and lower academic performance. Moreover, mobile phone use affected academic performance differently across practical and theoretical lessons.

Conclusion: Overall, our study highlights the potential negative impact of excessive mobile phone use on students' attention and academic performance.

Keywords: Academic performance, Attention, Mobile phone addiction

Please cite this paper as:
Siyami M, Rastgoo Moghadam M, Akbari Avaz Kh. Investigating the effect of mobile phone use on students' attention span and academic performance. Journal of Fundamentals of Mental Health 2023 Jul-Aug; 25(4): 271-277.

Introduction

Today, mobile phones have become an integral part of our daily lives, serving as a powerful manifestation of modern communication technology. However, their extreme use has become a growing concern among researchers, especially regarding their potential biological effects. Alarming statistics show that this trend has now spread to the student community. Although smartphones with advanced features have become a significant recent development, there still needs to be long-term studies that provide conclusive evidence of their positive or negative impact on schools. As professionals, we must objectively examine the effects of mobile phone usage and find ways to improve their role in our lives, especially in education. A review of the research conducted in the field of mobile phone use, which was mostly in the field of driving, shows that mobile phone use reduces users' attention. These researches show that using a mobile phone while driving increases the reaction time of drivers to stop the vehicle (3),

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Received: Mar. 17, 2022
Accepted: May. 15, 2023

distracts and reduces the performance of drivers (4), and increases risky behaviors in drivers (5). In addition, there is a positive relationship between defects in the ability to divide attention and driver distraction (6).

Attention is a crucial cognitive aspect impacted by excessive mobile phone use (7). This skill is essential for future academic success (8). Selective attention can be enhanced to improve focus and minimize distractions in learning environments (9). While studies have shown decreased attention when mobile phones are used while driving, research has primarily focused on academic performance within educational settings. Notably, teenagers with higher academic performance use mobile phones less than those with lower performance levels (10,11). As professionals, it is important to prioritize the development of attention skills in children and mitigate the negative impact of mobile phone use within educational environments. The field of mobile phone usage for education has shown some promising results in research studies (12- 14), indicating that it can serve as a useful tool in improving the teaching and learning experience (15), conducting online classes, and increasing satisfaction levels amongst students (16), and providing mobile learning opportunities outside the traditional classroom setting (17).

However, there remains a dichotomy in the literature between the positive role of mobile phones as an educational aid and their use as a means of communication and entertainment. This study focuses on the latter usage, exploring the simultaneous effects of mobile phones on both attention and academic performance. Furthermore, academic achievement is assessed based on the theory of the central source of attention, separating theoretical and practical courses into distinct categories. Overall, the context in which mobile phones are used plays a significant role in their impact on academic success, making it important to consider the specific phone usage conditions when analyzing their effects. Attention is a precious commodity that is limited and has a fixed central source. All activities compete for access to it, and the simultaneous execution of several tasks can cause overload on the limited capacity of attention. Human processing has two separate channels - the auditory/verbal channel for processing auditory inputs and verbal visualizations and the visual/visual channel for processing visual inputs and visual visualizations (18). It is now clear that when objects of competing tasks are different, people perform better in dividing their attention. For instance, a visual task combined with an auditory task interferes with less than two visual tasks (19). Our current research seeks to answer two key questions. Firstly, to what extent can the use of mobile phones affect students' attention and academic performance in the educational system? Secondly, we explore whether academic performance in theoretical and practical courses is affected differently based on whether two tasks are the same or two opposite types.

Materials and Methods

This causal-comparative study, students of art high schools of Darmian city-Iran were enrolled. To ensure the accuracy of our results, we followed the recommendation of Delavar (20) and selected a sample size of at least 30 individuals for each group. Due to the time-consuming nature of the Stroop test, we decided to include 40 participants per group. To begin, we administered a mobile phone addiction questionnaire to all students. Based on their scores, we categorized them into normal users, students with moderate overuse, and extreme mobile phone users. We purposefully selected 40 students (20 girls, 20 boys), from each group to participate in the selective attention test, also known as the Stroop test. Participants who did not complete the mobile phone addiction questionnaire or the Stroop test were excluded from the study. All students participated voluntarily, and information was kept confidential.

Research instruments

A) Mobile Phone Addiction Questionnaire: Jafarzadeh's mobile phone addiction questionnaire has 22 questions formed under the title of three sub-tests. This test is based on a Likert scale with five grades (completely false, false, somewhat true, false, and completely false). The total score ranges 22-110. Jafarzadeh reported the reliability coefficient of this questionnaire calculated by Cronbach's alpha as 0.90 (21).

B) Computerized Stroop Test: This test was first created in 1935 by Ridley Stroop to measure selective attention and cognitive flexibility. The computerized version of this test, which was also used in the present study,

includes two stages. First stage: Naming the color; in this stage, the subject is asked to specify the desired circle color in a set of colors. The purpose of this stage is only to practice and recognize the colors of keys and location on the keyboard, and it has no effect on the final result. The second stage: The main implementation of the Stroop test. At this stage, the number of 48 consonant words and 48 dissonant words with red, blue, yellow, and green colors are shown to the subject. Incongruous words mean that the color of the word is different from its meaning. 96 consonant and dissonant color words are displayed randomly and sequentially. The subject's task is to determine the appearance of the words regardless of their meaning. The validity of this test has been reported as more than 0.80 (22). The validity of this test has been reported in the range of 0.80 to 0.91 through retesting (23).

C) Academic Performance Test: To measure the academic performance of students in theoretical and practical courses, for each student (who were studying in different fields), two practical courses and two theoretical courses were selected randomly. Then the scores were coordinated with the relevant schools were asked.

Data were analyzed using SPSS-20, descriptive statistics, and one-way analysis of variance.

Results

In this study, 120 students (mean age= 17 years) were participated (20 boys and 20 girls in each group of normal users, moderate over users, and extreme mobile phone users. Our findings indicate that mobile phone usage significantly impacts attention spans. The findings showed that the mean of Stroop test score in normal students, students with moderate overuse, and extreme users were 0.55 ± 1.28, 0.50 ± 2.18, and 1.60 ± 2.69, respectively. So, the group with moderate overuse had the lowest score, whereas extreme phone users had the highest score. We conducted a one-way analysis of variance to determine the significance of the difference in selective attention (interference score) among the groups (Table 1).

Table 1. The results of the variance analysis to compare the mean of selective attention in three groups

Variable	Sources	Sum of squares	df	Mean of squares	F	P
Interference score (test result)	Between-groups	30.867	2	15.433	3.385	0.037
	Within groups	533.500	117	4.560		
	Total	564.367	119			

Where we notice a noteworthy difference in the interference score (test result) between certain sample groups (F= 3.385, *P*< 0.05). To delve deeper, Tukey's test will be utilized (Table 2).

Table 2. Tukey's follow-up test comparing means in selective attention

Variable	Group	Group	Mean difference	Std. Error	P
Interference score (test result)	Normal use	Moderate over use	0.050	0.477	0.994
		Extreme use	-1.050	0.477	0.036
	Moderate over use	Extreme use	-1.100	0.477	0.059

The Tukey's test highlights a noteworthy contrast in interference score averages among students with normal use and extreme mobile phone use. The table shows that students with extreme use face more interference than their low-usage counterparts. According to our findings, mean scores of academic performance in students with normal mobile phone use, moderate overuse, and extreme use were 16.53 ± 3.90, 14.71 ± 2.50, and 14.84 ±2.00, respectively.

Table 3 displays the descriptive indicators of academic performance test results for groups and different courses.

Table 3. Descriptive indicators of academic performance among groups and different courses

Groups	Course	Mean	Standard deviation	Lower bounds	Upper bounds
Normal use	Theoretical courses	16.71	7.33	8.62	58.38
	Practical courses	16.35	2.10	11.25	20.00
Moderate overuse	Theoretical courses	13.61	2.67	6.75	17.88
	Practical courses	15.82	2.75	6.25	19.75
Extreme use	Theoretical courses	13.21	2.61	7.75	19.25
	Practical courses	16.48	2.12	11.62	19.50

A one-way analysis of variance was conducted to test the significance of the difference between the means of these groups, and the results are presented in Table 4.

Table 4. The results of the one-way analysis of variance in the academic performance

Variable	Sources	Sum of squares	df	Mean of squares	F	P
Academic performance	Between-groups	82.102	2	41.051	4.816	0.010
	Within groups	997.315	117	8.524		
	Total	1079.417	119			
Theoretical courses	Between-groups	294.015	2	147.008	6.500	0.002
	Within groups	2646.113	117	22.616		
	Total	2940.129	119			
Practical courses	Between-groups	9.924	2	4.962	0.901	0.409
	Within groups	644.541	117	5.509		
	Total	654.466	119			

The results from Table 4 indicate that the use of mobile phones has a significant impact on student's academic performance and there were significant differences between groups (F= 4.816, *P*< 0.05). Furthermore, the findings showed that students' academic performance in theoretical courses significantly differs among at least two groups of users (F= 6.500, *P*< 0.01). In contrast, there was not significant difference between groups observed in practical courses (F= 0.901, *P*= 0.409). Tukey's follow-up test was conducted to determine the differences between each of the three groups accurately, and its results are presented in Table 5.

Table 5. Tukey's follow-up test comparing the means of academic performance score by separating the type of course (theoretical and practical)

Variable	Group	Group	Mean difference	Std. Error	P
Academic performance	Normal use	Moderate overuse	1.81688	0.65284	0.017
		Extreme use	1.68500	0.65284	0.030
	Moderate overuse	Extreme use	-0.13188	0.65284	0.978
Theoretical courses	Normal use	Moderate overuse	3.10125	1.06340	0.012
		Extreme use	3.50312	1.06340	0.004
	Moderate overuse	Extreme use	0.40187	1.06340	0.924
Practical courses	Normal use	Moderate overuse	0.53250	0.52483	0.569
		Extreme use	-0.13312	0.52483	0.965
	Moderate overuse	Extreme use	-0.66563	0.52483	0.416

Table 5 reveals a noteworthy contrast between the academic performance of normal users and the academic performance of students with moderate overuse and extreme users. Nonetheless, there is no difference in the academic performance of students with moderate overuse and extreme users (*P*= 0.978).

Additionally, these indicators demonstrated that the academic performance in theoretical courses was different significantly between groups with normal use and moderate overuse, and between groups with normal use and extreme use. However, the groups' academic performance in practical courses was similar.

Discussion

The present study has confirmed a reduction in attention amongst extreme mobile phone users compared to those who use their phones sparingly. Excessive usage of mobile phones has been found to cause disturbances in attention, resulting in decreased focus. The findings are consistent with previous study by May and Elder (24). Similarly, Fischer et al. found that mobile phone use in the classroom significantly decreased the focus on academic tasks, such as note-taking during a movie while the phone is ringing (25). The results of the present study align with Thomas et al.'s research on high school students in Melbourne, which indicates that excessive mobile phone use can lead to cognitive difficulties. The evidence suggests that reducing mobile phone usage can improve attention and cognitive performance (26).

When examining the issue, we can rely on the theory of the central source of attention. This theory states that attention capacity is limited and has a fixed central source. Therefore, all activities contend with one another to access it. This means that part of our attention resources are allocated to our mental occupations without our awareness, causing a reduction in the amount of attention accessible to us. To elaborate on these three concerns, we can reference the study by Strayer et al., which demonstrated that speaking on a mobile phone consumes mental resources. If this activity is eliminated, those mental resources, such as driving, will be dedicated to the primary task (27). The findings suggest a correlation between increased mobile phone usage and a decline in academic performance. This aligns with previous research, such as Lin and Chiang's study on Singaporean students, which indicated that improper phone use mediates the impact of smartphone addiction symptoms on academic performance and perceived sociability (28).

Fleisoni and Godoi studied on 43 students in Sao Paulo, Brazil, prolonged usage of smart mobile phones correlates with a decrease in academic ranking (29). This aligns with Sadoughi's study on 172 students at Kashan University, which found that excessive mobile phone use is negatively linked to academic performance (30). Moreover, Samaha and Hawi studied on 300 students and revealed a significant correlation between excessive mobile phone usage, stress, and poor academic performance (10). These findings emphasize the detrimental impact of excessive mobile phone usage on academic performance and suggest the need for a mindful approach to technology.

Considering this research finding, it is important to address two issues: Firstly, mobile phones, with their plethora of features, have become a hub for playing computer games and browsing social and dating networks. Unfortunately, this has resulted in many individuals losing their ability to manage time effectively and wasting precious hours on these technologies. Furthermore, excessive use of mobile phones has been linked to sleep disorders among users, leading to inadequate study time and underperformance in academics. These findings are consistent with Fook et al.'s research, which suggests that mobile phone addiction increases the desire for prolonged use (31). The misuse of mobile phones in school has been well-documented through various studies. Shockingly, 92% of students admitted texting, browsing the web, or using social media during class. Furthermore, Rosen et al. found that students spend an average of 6 minutes during a 15-minute session watching TV or engaging in online activities, suggesting a potential increase in phone usage and further distraction (32). This finding, however, can be explained by Baddeley's model, which identifies the central executive as a component of working memory responsible for attention control. Therefore, disturbances caused by phone use can lead to problems in working memory and inattentive behavior. Most students with low working memory scores also had high cognitive inattention symptoms, indicating a short attention span and a high distraction (33). Considering mentioned issues, we must acknowledge the benefits of modern technology, namely smart mobile phones, in enhancing the quality of life and facilitating the teaching-learning process. However, recognizing the detrimental effects of excessive usage, including addiction and physical harm, is equally important. To safeguard students' academic performance and well-being, we must educate them on the direct and indirect consequences of excessive mobile phone use and implement behavioral and cognitive interventions to modify their usage patterns. Additionally, educational institutions should explore alternative programs to prevent cell phone addiction.

Conclusion

The result of this study highlight the potential negative impact of excessive mobile phone use on students' attention and academic performance.

Acknowledgments

The authors thank the students of art high schools in Darmian city. The authors declare no conflict of interest and no funding.

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