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Disruptive Harmony: Why Classical Music Impairs Attention In Smartphone-Addicted Students

Harmoni yang Mengganggu: Mengapa Musik Klasik Menurunkan Atensi Pada Mahasiswa Adiksi Smartphone

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Abstract

Excessive smartphone use among university students has been linked to a decline in cognitive control, particularly in the aspect of attention. The use of classical music is often considered a strategy for enhancing attention, yet its effectiveness in individuals with digital addiction still requires empirical testing. This study aims to determine the effect of classical music (Mozart K. 448) on the attention of students experiencing smartphone addiction. This experiment employed a two-group posttest-only design involving 60 students selected through purposive sampling. Attention was measured using a time-based Stroop Test (ms). The Mann-Whitney U test results showed a significant difference between the two groups (Z = -3.713; p < .001). The experimental group had a higher mean rank for reaction time (38.87) compared to the control group (22.13). These findings indicate that classical music acts as a cognitive distraction that decreases attention in students with smartphone addiction; therefore, the use of background music should be considered selectively.

Keywords : *smartphone addiction, students, reaction time*

Abstrak

Penggunaan Smartphone yang berlebih pada mahasiswa telah dikaitkan dengan penurunan kontrol kognitif, khususnya pada aspek atensi. Pengguna musik klasik sering kali dianggap sebagai strategi dalam meningkatkan atensi, namun efektivitasnya pada individu dengan adiksi digital masih memerlukan pengujian empiris. Penelitian ini bertujuan untuk mengetahui pengaruh musik klasik (Mozart K. 448) terhadap atensi mahasiswa yang mengalami adiksi smartphone. Eksperimen ini menggunakan two-group posttest-only design terhadap 60 mahasiswa yang dipilih melalui *purposive sampling*. Atensi diukur menggunakan Stroop Test berbasis waktu (ms). Hasil uji Mann-Whitney U menunjukkan perbedaan signifikan antara kedua kelompok (Z = -3.713; p <.001). Kelompok eksperimen memiliki mean rank waktu reaksi lebih tinggi (38.87) dibandingkan kontrol (22.13). Temuan ini menunjukkan bahwa musik klasik merupakan distraksi kognitif yang menurunkan atensi pada mahasiswa dengan adiksi smartphone sehingga penggunaan musik latar perlu dipertimbangkan secara selektif.

Kata Kunci : adiksi *smartphone*, mahasiswa, waktu reaksi

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INTRODUCTION

Smartphones have become an integral part of college students' lives, contributing to changes in cognitive function, particularly attention and cognitive control. Numerous studies have demonstrated that constant exposure to digital stimuli, such as notifications and social media access, can disrupt attentional processes, reducing an individual's ability to focus on primary tasks (Marty-Dugas et al., 2018; Wilmer et al., 2017). In fact, the mere presence of smartphones has been shown to decrease cognitive capacity and increase distractions during learning activities (Ward et al., 2017).

In the other hand, smartphones also provide benefits in an educational context. For example, they provide easy access to learning resources and flexibility in the learning process, thereby improving learning outcomes. This flexibility enables students to learn independently and adaptively according to their needs and learning context (Crompton & Burke, 2018; Sung et al., 2016). However, However, uncontrolled smartphone use can cause fragmented attention. For example, the habit of frequently checking smartphones can disrupt concentration, making it difficult for students to focus during learning activities or lectures (Goktas Aydin et al., 2025; Mendoza et al., 2018; Singh & Sarkar, 2012).

his phenomenon is becoming increasingly relevant, especially in Indonesia, given the high penetration of smartphones. According to data from the Central Statistics Agency (BPS), approximately 92.14% of the population aged 15–24 and 74.80% of those aged 25–64 owned or were able to use a mobile phone in 2023 (BPS, 2024). Globally, more than 5.8 billion individuals use mobile devices, equivalent to approximately 70% of the world's population, with a penetration rate of 68% (Kemp, 2025a).

In Indonesia, a report from the Indonesian Internet Service Providers Association (APJII) shows that, by 2024, 221.56 million people will use the internet, equivalent to 79.5% of the population. More than 98% of these individuals will access the internet via smartphones (Haryanto, 2024). Furthermore, recent data shows that the number of mobile connections in Indonesia has reached 356 million, exceeding the population and reflecting the widespread use of multiple devices. Additionally, the number of internet and social media users in Indonesia has increased in recent years (Kemp, 2025b). These data indicate that smartphone penetration in Indonesia continues to grow rapidly, reflecting significant changes in people's digital behavior and the important role of technology in everyday life.

dditionally, excessive smartphone use has been associated with sleep disorders, such as insomnia, and increased anxiety levels, which can ultimately impact students' well-being and academic performance (Liu et al., 2022; Rathakrishnan et al., 2021). Students often report spending excessive time on social media, which can lead to procrastination and reduced time for physical activity (Giunchiglia et al., 2018; Meier et al., 2016). While smartphones undeniably open up numerous educational opportunities, their potential for distraction also presents challenges. Therefore, students must manage their smartphone use wisely to maximize its benefits without sacrificing their concentration and academic success.

Several studies in Indonesia have examined the relationship between smartphone addiction and academic achievement among students. The average Indonesian SAS-SV score for male students was 35.09, while the average score for female students was 36.11. The cutoff values analyzed by the ROC test for both genders were determined. For males, the cutoff value was ≥31.5, with sensitivity and specificity values of 97.4% and 97.3%, respectively. These values were not significantly different from those of females, who had a cutoff value of ≥33.5, with 91% sensitivity and specificity (Arthy et al., 2019). Another study examined the relationship between smartphone addiction and academic achievement among students. The results showed a significant correlation between academic stress and smartphone addiction (Samaha & Hawi, 2016).

Excessive smartphone use has been linked to decreased learning, attention, and academic achievement (Lepp et al., 2014; Yadav et al., 2021). One study found that high smartphone use intensity was associated with lower academic achievement in adolescents (Kliesener et al., 2022). Furthermore, smartphone addiction can negatively impact various aspects of adolescents' personal and academic lives, including attention regulation and identity formation (Sunday et al., 2021).

One widely researched approach is the use of music as a stimulus to support learning activities. Music, particularly classical music, is known to influence mood and reduce anxiety. Furthermore, it increases an individual's cognitive readiness to complete tasks (Schellenberg, 2005; Thompson et al., 2001).

Research by Aryanto & Megananda (2020) found that music with a slow tempo, such as classical music with a stable rhythm and harmonious structure, increases students' attention compared to a learning atmosphere without music or with music having a fast tempo. This is because slow-tempo music is considered to create a more comfortable learning atmosphere. Ázmi et al. (2023) found that instrumental classical music, in particular, can reduce boredom and improve mood, indirectly enhancing students' ability to absorb course material. Participants tended to feel more focused when studying or working on assignments with background music than in a quiet environment. This was demonstrated by an increase in the number of times they reported feeling focused when music was playing.

This means that background music helps direct participants' attention to the task at hand, reducing the likelihood that they will wander or become distracted. However, according to Nadon et al. (2021) not all types of music positively affect attention. Calming music increases attention and reduces errors in cognitive tasks, whereas stimulating music does not improve performance as expected and can lead to more errors. Therefore, choosing the right music is crucial for optimizing performance in tasks requiring selective attention.

Recent research by Chen (2024) also shows that carefully selected classical music can help improve memory and reduce psychological stress while studying. Further research by Ead et al. (2024), and the results of student perception studies by Malasmas et al. (2023) support the benefits of classical music in learning activities. However, these studies emphasize that the effect of music on academic achievement varies depending on each individual's personal preferences and psychological state.

The emerging paradox regarding the influence of music on cognition provides new discussion, particularly regarding the limited attentional capacity of students experiencing smartphone addiction. Research on the effectiveness of music on attention in individuals with smartphone addiction is still limited, so this study offers a new contribution to understanding the interaction between auditory stimuli and limited attentional control in this population. Therefore, this study aims to analyze the influence of classical music on the attention of students experiencing smartphone addiction as a basis for consideration in creating a conducive learning environment.

RESEARCH METHODS

This study employed a quantitative approach with a two-group posttest-only design. There were 60 research subjects, who were divided into an experimental group (n = 30) and a control group (n = 30). Participants were selected using Purposive Sampling with the following inclusion criteria: (1) active students, (2) identified as having smartphone addiction based on a SAS-SV score of at least 31.5 for males and at least 33.5 for females, (3) free of hearing impairments, and (4) willing to complete the experimental procedure.

Data analysis used nonparametric statistical analysis with the Mann-Whitney U test. The test examined the difference in response time between the experimental group, which listened to classical music, and the control group, which did not. The analysis aimed to determine if there was a significant difference in attention levels between the two groups. The data obtained from the Stroop test will be analyzed using SPSS 29 software to test the hypotheses proposed in this study.

This study used the Stroop Test to measure attention levels. The test assesses an individual's ability to maintain attention and control responses to distracting stimuli. Scores are based on the number of correct responses and the average reaction time in milliseconds during the test. The test consisted of 60 items in the form of incongruent color and word identification tasks. A higher number of correct responses and a faster reaction time indicate a higher level of attention.

In this study, attention was measured using the web-based Stroop Test. Since this is a performance-based task, its psychometric properties are based on response stability and experimental sensitivity rather than the internal consistency of the items, as is the case with self-report scales (Strauss et al., 2006). The Stroop Test has been proven to have excellent test-retest reliability, with stability coefficients ranging from $r = 0.80$ to 0.91 (Jensen & Rohwer, 1966; Strauss et al., 2006). It has been used in various cognitive psychology studies to measure attention and cognitive control (Goktas Aydin et al., 2025; Otsuka et al., 2026).

This instrument's construct validity is based on the Stroop interference phenomenon, which measures the ability to distinguish between automatic (reading) and controlled (color identification) cognitive processes (MacLeod, 1991). Attention levels were measured by average reaction time in milliseconds (ms) and number of accurate responses. In this study, score interpretation was carried out comparatively by analyzing the differences between the experimental and control groups. The instrument's ability to detect significant differences in this study ($p < 0.001$) with an effect size of 0.48 indicates the instrument's empirical validity and its high sensitivity in capturing the effect of treatment on participants' attention performance (Cohen, 2013; Field, 2018).

In addition, the psychometric properties of the instruments in this study were proven through convergent validity. The test results showed a significant negative correlation between mean reaction time and accuracy scores ($r_s = -0{,}435$; $p < 0{,}001$). This shows that the instrument is valid in measuring attention capacity, namely cognitive efficiency which is characterized by response speed while maintaining the accuracy of the results (Heitz, 2014; Prinzmetal et al., 2005).

RESEARCH RESULT

The characteristics of the respondents in this study are as follows: There were five male respondents (8.3%) and 55 female respondents (91.7%). Of the respondents, 45 (75.0%) were between 18 and 22 years old, 11 (18.3%) were between 23 and 27 years old, and 4 (6.7%) were 27 years old or older. The respondents were divided into two study programs: Sharia Economics and PIAUD. Of the respondents in the Islamic Economics Study Program, 30 people (50%) participated, the same number as in the PIAUD Study Program. The respondents also consisted of students in semesters two, four, and six. Sixteen respondents (26.7%) were in semester 2, 19 respondents (31.7%) were in semester 4, and 25 respondents (41.7%) were in semester 6. The details are as follows.

Table 1. Respondent Characteristic

Characteristics	Category	Frequency (n)	Percentage (%)
Gender	Male	5	8,3
	Female	55	91,7
Age	18–22 years	45	75,0
	23–27 years	11	18,3
	≥27 years	4	6,7
Study Program	Islamic economics	30	50,0
	PIAUD	30	50,0
Semester	Semester 2	16	26,7
	Semester 4	19	31,7
	Semester 6	25	41,7

Based on the results of the Smartphone Addiction Scale – Short Version (SAS-SV) screening, all participants (N = 60) scored above the cutoff threshold. This indicates that all subjects fell into the moderate to high smartphone addiction category. The average scores and distribution by gender are detailed in the following table.

Table 2. Average Smartphone Addiction Scores

Gender	Mean	SD	Score Range
Male	37,00	5,95	33 – 45
Female	40,82	5,33	34 – 54

The average smartphone addiction score for male participants was 37.00 (SD = 5.95), ranging from 33 to 45. Meanwhile, the average score for female participants was 40.82 (SD = 5.33) with a range of 34 to 54. Overall, these data indicate that the smartphone addiction scores of both male and female participants were in the moderate to high range. These results align with those of the validation study of the Indonesian version of the Smartphone Addiction Scale - Short Version (SAS-SV) by Arthy et al. (2019), which stated that the cutoff value for the addiction category is ≥31.5 for males (with a sensitivity of 97.4% and a specificity of 97.3%) and ≥33.5 for females (with a sensitivity of 91%). Thus, it can be concluded that all participants in this study met the criteria for the target population, which is individuals with a tendency to be addicted to smartphone use.

Attention was measured using the Stroop Test and analyzed based on average reaction time in milliseconds (ms). To determine the direction of performance differences between groups, a mean rank comparison was performed, as shown in the following table.

Table 3. Distribution Table of Individual Attention Conditions based on Threshold Values (N = 60)

Group	Fast Reaction Time ($\leq$ $1417\ ms$)	Slow Reaction Time (>1417ms)	Total Respondents
Experiment	13	17	30
Control	23	7	30

Note. The threshold of 1417 ms was determined based on the grand mean of all participants.

Based on table 3, it can be seen that the experimental group tended to have lower attention than the control group. Using the combined average reaction time of 1417 ms as the threshold, it was found that the majority of respondents in the experimental group (17 respondents) showed a slower responses duration. Meanwhile, in the control group (23 respondents) were able to maintain a fast response duration. This distribution is consistent with the following analysis of the mean rank comparison between groups.

Tabel 4. Comparison of *Stroop Test Reaction Time Mean Ranks*

	Group	N	Mean Rank	Sum of Ranks
Avarage time/ms	Experiment	30	38.87	1166.00
	Control	30	22.13	664.00
	Total	60		

In reaction time, a higher number in reaction time indicates a longer response duration, meaning slower response times. The results show that the experimental group has a higher mean rank than the control group, indicating lower levels of attention in the experimental group. This is because the subjects took longer to process visual stimuli while listening to classical music.

The results of the normality test using *Shapiro-Wilk* for the average time (ms) shows a statistical value of 0.536 with degrees of freedom (df) = 30 for the experimental group with a significance value, namely p = <0.001 (<0.05), which is not normally distributed. Then, for the control group shows a statistical value of 0.950 with degrees of freedom (df) = 30 and a significance value of p = 0.165 (>0.05), which is normally distributed data. Because one of the groups did not meet the normal distribution criteria, the normality assumption for the use of parametric statistics was declared unfulfilled.

Homogeneity test was conducted using Levene's test to determine the similarity of variances between the experimental and control groups. The results of the analysis showed a Levene statistic value of 4.434, with a significance level of p = 0.040 (p < 0.05). This indicates that the variance in the data between the two groups is not homogeneous. Therefore, the two assumptions are not met. Thus, a nonparametric statistical analysis using the Mann-Whitney U test was conducted because this test does not depend on specific distribution parameters. It works based on ranks, providing valid results regarding the level of attention between the experimental and control groups (Field, 2018; Nahm, 2016; Sedgwick, 2015).

Table 5. Results of the Mann-Whitney U Analysis of Reaction Times

	Avarage Time (ms)
Mann-Whitney U	199.000
Z	-3.713
Asymp. Sig. (2-tailed)	<,001

*Note: The analysis results show the difference in mean time (in milliseconds) between the experimental and control groups. The presented coefficients are U statistics from the standardized Mann-Whitney test. **p < .001.*

Based on Table 4, a statistically significant difference was found in the average time (ms) between the two compared groups. As seen in the table above, the values are U = 199,000 and Z = -3.713, with a significance value of $p < 0.001$. This value is smaller than the standard significance level of 0.05, indicating a difference between the classical music group and the control group. Using the Z/√N formula, the effect size is 0.48, showing that classical music has a medium effect on differences in attention levels between groups (Cohen, 2013; Field, 2018; Lakens, 2013).

Discussion

The results of the study revealed significant differences between students who listened to classical music and those in the control group. The experimental group had a longer reaction time than the control group on the Stroop Test. In the context of measuring attention, reaction time is a commonly used indicator of an individual's level of attention. Faster responses reflect optimal attention, while slower reaction times are associated with attentional lapses or an inability to maintain focus on a task (Fortenbaugh et al., 2017; Löffler et al., 2021; Smallwood et al., 2004). These findings suggest that listening to classical music while working on a task may negatively impact students' attention levels.

his contradicts the findings of Ázmi et al. (2023) who discovered that background music, particularly instrumental classical music, can alleviate boredom and enhance mood. Consequently, it can indirectly enhance students' capacity to absorb course material. Participants tended to feel more focused when studying or working on assignments with background music than in a quiet atmosphere. This difference may be due to the classical music used, specifically Mozart's Sonata K 448, which has a fast tempo and beat. However, this fast tempo and beat can distract participants who are required to solve problems that demand high focus. This finding aligns with research by Chou (2010) who discovered that high-intensity music (e.g., fast tempo, high volume) disrupts concentration during cognitive tasks.

In Addtion, tempo charactestics and music preferences also influence the level of arousal or mental readiness of participantas. According to Kiss & Linnell (2021), preferred music helps participants focus more on the task at hand. Preferred music increases arousal levels to optimal levels, supporting a more focused state of attention. However, without personalized music selection, classical stimuli can become a distraction during task completion (Nadon et al., 2021).

In addition to these factors, the characteristics of participants with smartphone addiction require primary attention. Smartphone addiction is known to cause significant attention fragmentation and impaired concentration in users (Singh & Sarkar, 2012). Those with smartphone addiction tend to have difficulty focusing on a single task due to repeated multitasking or distractions from digital notifications. In this context, classical music, which is typically considered a supportive stimulus, can actually create an additional cognitive burden for participants. This aligns with research Prasetyadi & Gustaman (2022) which shows that increased smartphone use and higher addiction levels are associated with decreased attentional capacity and increased distractibility.

A neurocognitive study using fMRI by Han & Kim (2022), showed that individuals at high risk for smartphone addiction experience significant impairments in shifting their attention consciously (endogenously) from an engaging stimulus (distractor) to a primary task. These individuals exhibited lower activation in the frontopolar cortex (FPC), a brain region critical for attention control, goal planning, and self-regulation. This low FPC activity suggests that individuals with smartphone addiction have difficulty maintaining focus and returning quickly to the main task after being interrupted, especially by attention-grabbing distractors such as notifications, sounds, or fast-paced music.

This could explain why the experimental group treated with classical music had longer reaction times, indicating slower thinking processes. Music with a relatively fast tempo, which may not suit your preferences, can exacerbate attention deficits caused by smartphone addiction. In this case, individuals with smartphone addiction exhibit symptoms of selective attention disorder, or difficulty filtering out excess information (Hadar et al., 2017).

Excessive activity in the brain's reward system (dopaminergic) and decreased control in the prefrontal cortex make individuals with smartphone addiction more susceptible to distraction by external stimuli, including classical music (Han & Kim, 2022). The Stroop test, which demands selective attention, could not be carried out optimally in this study due to internal conflicts between visual and auditory stimuli. Thus, classical music, initially assumed to improve attention, became an additional cognitive burden for participants already experiencing attentional difficulties. These findings suggest that the effects of music on attention are contextual and influenced by individual characteristics and the type of stimulus used.

Conclusion

The results of the study showed that classical music affected the attention of students with smartphone addiction. A Mann-Whitney U test revealed a significant difference between the group that listened to classical music and the control group. Students who listened to classical music had slower reaction times, indicating lower levels of attention. Thus, classical music did not improve attention in this study but rather tended to be a distraction.

Implications for future research include considering the type of music used in treatment, particularly in terms of tempo, intensity, and genre, as well as adapting it to participants' musical preferences. Music that does not match participants' preferences can be distracting. Furthermore, future researchers can replicate this study in different settings, such as with different age groups or environments. They can also provide other treatments to improve attention for individuals experiencing smartphone addiction, such as daily digital detoxes or mindfulness training.

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