Digital Overload and Cognitive Fatigue among Adolescents: Understanding the Cognitive Costs of Constant Connectivity

1. *Dr. Meenakshi Jindal, Lecturer Physics, email: meenu20nov@gmail.com*
2. *Vivaan Veer Sood, Student, email:vivaanveersooduni@gmail.com*
3. *IshratKaurNotay, Student, email: ishratkauruni@gmail.com*
4. *AkshayNagpal, Student, email:akshaynagpaluni@gmail.com*
5. *AnkshitaBangia, Student, email: ankshitabangia@gmail.com*

Abstract

The advent of digital technology has reshaped adolescent life by providing endless opportunities for communication, connectivity, learning, and entertainment. But it has also introduced new psychological and cognitive challenges for them. The present study investigates the relationship between digital overload and cognitive fatigue among adolescents, focusing on how digital engagement and constant connectivity affects their mental efficiency and well-being.

A sample of 110 adolescents from various schools in the Tricity of Chandigarh participated in the study. Data were collected using self-constructed Digital Overload and Cognitive Fatigue Scales administered through Google Forms. Pearson's coefficient of correlation was applied to analyze the data.

Findings revealed that adolescents spend considerable time on social media, messaging, and streaming platforms, reflecting high levels of digital engagement. Many reported compulsive phone-checking, difficulty in digital detoxing, and frustration with connectivity issues-(indicators of perceived overload). Statistical analysis showed a significant positive correlation between digital overload and cognitive fatigue ($r = .528$, $p < .01$), implying that increased digital exposure leads to higher cognitive strain.

The study emphasizes an important point that digital overload among adolescents arises not only from screen time but also from the psychological compulsion to remain constantly connected. It underscores the importance of promoting balanced digital habits to safeguard adolescents' mental and cognitive health.

Keywords: Digital overload, digital engagement, digital device usage, cognitive fatigue, adolescents, screen time, connectivity

Introduction

The rapid expansion of digital technology has fundamentally transformed life, especially of adolescents.Digital technology has revolutionized the ways in which adolescents communicate, learn, connect with others and even entertain themselves. Smartphones, social media platforms, and instant messaging applications have created an environment of constant connectivity, where information and interaction is just a tap away.

While this digital revolution has provided unprecedented access to information, it has also introduced new psychological and cognitive challenges. One emerging concern is **digital overload**—a state of mental saturation caused by excessive exposure to digital stimuli—and its consequent effect, **cognitive fatigue**.

Digital overload refers to the state of being overwhelmed by the constant flow of information and stimuli from digital devices such as smartphones, tablets, and computers.

According to the framework of cognitive theory, working memory in humans has limited capacity and an overload of multiple streams of information from digital devices can lead to decreased retention and learning capabilities (Suarez et al.,2024).

Smith et al. (2021) highlighted that digital overload occurs when information is received from multiple communication channels at a very high pace and it reduces or hinders the capacity of the brain to process this information efficiently. Within the same device like smartphone information is received from various sources like text messages, notification alerts, phone calls etc. and it leads to digital overload.

Among adolescents, this phenomenon has become increasingly common as they spend significant portions of their day connected to the internet for learning, social interaction, and entertainment. The constant exposure to notifications, messages, and online content demands continuous attention and mental engagement leaving little room forcognitive rest. Adolescents often multitask between academic work, social media, and online videos, leading to fragmented attention and reduced focus. Over time, this persistent digital engagement can result in mental exhaustion, irritability, and difficulties in concentration. Moreover, the pressure to stay constantly connected—driven by the fear of missing out (FOMO) and social validation—intensifies their dependence on digital platforms.

Cognitive fatigue refers to a state of mental exhaustion that occurs when the brain's cognitive resources are overused, leading to a decline in attention, concentration, and mental performance. Karim et al. (2024) defined cognitive fatigue as a state of diminished mental efficiency resulting from prolonged or intense cognitive activity. It is characterized by varying degrees of mental exhaustion that may persist over extended periods, even spanning several days. Once cognitive fatigue develops, individuals often experience significant difficulty in maintaining concentration and sustaining attention, even during routine tasks.

According to Holzer et al. (2010) cognitive fatigue presents a failure to sustain attention that requires self motivation to optimize performance. It can decrease performance over extended period of time or after a challenging mental or physical exertion

According to Shanmugasundaram, Mathura &Tamilarasu, Arunkumar (2023), the unlimited supply of information available through internet and social media creates a sense of urgency to stay informed and connected leading to multitasking which in turn lead to attention fragmentation and can prove to be detrimental to cognitive health.

Despite growing awareness of the issue, there remains a lack of comprehensive understanding of how digital overload translates into measurable cognitive fatigue in adolescents. Existing research often focuses on screen time duration, neglecting the intensity and quality of digital engagement. Moreover, the cognitive costs of "always being online" extend beyond simple distraction—they reshape cognitive patterns, information processing styles, and attention spans.

This study aims to explore the relationship between digital overload and cognitive fatigue among adolescents, seeking to uncover how constant digital engagement impacts their cognitive functioning. By examining the cognitive costs of connectivity, the research intends to provide insights that can guide educators, parents, and policymakers in promoting healthier digital habits and fostering a balanced relationship between technology and cognitive health.

Review of previous literature

Ophir et al. (2009) found that digital media multitasking is common these days but it is challenging for human brain to process huge information coming from different sources. When two groups were compared on the media multitasking index and its effect on cognitive control, it was found that heavy multitaskers were worse on the task switching ability than the light multitasking group. It was likely to be due to reduced ability to filter out irrelevant information.

Hasan (2024) in his article highlights the gaps in existing researches about digital multitasking and its effects on cognitive health and productivity. It identifies that long term influence of digital multitasking on cognitive health and decreased mental capacity is not sufficiently studied.It suggests the need of longitudinal studies on changes in brain activity, cognitive and mental health due to digital multitasking. Further it suggests that there is a need of more intervention studies aiming at reducing the harmful effects of multi tasking for example mindfulness training and digital detox etc.

Tafesseetal. (2024) examined the effect of digital overload on the psychological well being of students of a Public University in United Arab Emirates. It also studied how use of coping mechanisms can be helpful in mediating the negative effects of digital overload.The results show that digital overload causes psychological strain through techno-stress and exhaustion.Also coping mechanism is positively associated with student engagement.Students who use coping mechanism show more emotional,cognitive and behavioral engagement with their academic study.

Ma, Liu & Zhang (2025) investigated the negative impact of excessive social media use among college students on learning burnout and academic performance. The study characterized excessive social media use as a stressor which is further divided into three types- excessive social,excessive hedonic and excessive cognitive. The results show that excessive social and hedonic use significantly increase learning burn out whereas excessive cognitive use reduces it.Learning burnout negatively impact academic performance. Mindfulness acted as moderating variable to mitigate the adverse effect of excessive social media use.

Subardjo,& Khan (2025)examined the effect of digital multitasking on mental health, productivity and cognitive load. Although there is an apparent increase in productivity, there are significant cognitive and psychological tradeoffs. Rapid switching between digital tasks like browsing the social media,attending the notifications or even answering a phone call increases cognitive load and impaired brain ability to retain knowledge and comprehend it deeply.There is significant reduction in the working memory, attention span and emotional control.

Wang et al. (2025) examined the effect of information and social overload on fatigue, cognition and academic performance of 320 universities students in China. Study particularly focused on the moderating role of self control.The results showed that excessive use of information leads to mental exhaustion in students which in turn reduces the capacity to concentrate and process information. Self control emerged as an important moderator in managing negative effects of social media over use.

Objectives

1. To study the digital overload in terms of digital device usage among adolescents.
2. To study the digital overload in terms of digital engagement among adolescents.
3. To study the relationship between digital overload and cognitive fatigue among adolescents.

Hypothesis

- There is no significant correlation between digital overload and cognitive fatigue among adolescents.

Sample

The population of the study is all the adolescents studying in various schools of tricity of Chandigarh. A Sample of 110 adolescents was taken from the said population. A Google form was prepared and mailed to the sample students for collection of data.

Tools used

Following tools were used to collect the data:

1. Digital overload scale- (digital device usage and digital engagement) constructed by the investigators.

2. Cognitive fatigue scale constructed by the investigators.

Procedure and collection of data

The research was conducted to study the relationship between digital overload and cognitive fatigue among adolescents. A sample of 110 adolescents was taken to study the problem at hand. Digital overload scale (digital device usage and digital engagement) and Cognitive fatigue scale constructed by the investigators were administered to collect the data. The data was collected through Google forms. The data were subjected to statistical analysis. The results and conclusions were drawn out from there.

Statistical tools used

Descriptive statistics and Pearson's coefficient of correlation technique was used to analyse the data.

Analysis of data

To analyze the data, percentage distribution of digital overload in terms of digital device usage and digital engagement among adolescents was done. Also Pearson coefficient of correlation was found between digital overload and cognitive fatigue.

Objective 1 studies the digital overload in terms of digital device usage among adolescents. The percentage distribution is given in the following table in terms of number of hours.

Table1: Percentage distribution of digital overload- digital device usage by adolescents

S.No.	Components	1-2 hours	2-4 hours	More than 4 hours
1.	Messaging/chat applications (WhatsApp, Discord,	71.2	19.8	9

	Snapchat, etc.)			
2.	Social media applications (Instagram, Twitter, etc.)	28.8	45.9	25.2
3.	Academic activities	33.3	41.4	25.2
4.	Streaming/OTT platforms (Youtube, Netflix etc.)	74.8	16.2	9

Table 1 presents the percentage distribution of digital device usage among adolescents.

Nearly all adolescents in the Tricity region reported owning and regularly using smartphones, with consistent internet access available in their homes. A majority (71%) of respondents indicated that they spend approximately 1–2 hours per day on messaging and chat applications such as WhatsApp, Discord, and Snapchat, while 20% reported 2–4 hours, and 9% spend more than 4 hours on these platforms.

In terms of social media usage (including platforms such as Instagram and Twitter), 46% of adolescents reported spending 2–4 hours daily, 26% spend over 4 hours, and 29% spend 1–2 hours per day.

With regard to streaming and Over-The-Top (OTT) platforms such as YouTube and Netflix, 75% of respondents spend 1–2 hours daily, 16% spend 2–4 hours, and 9% spend more than 4 hours.

In contrast, academic application usage was observed to be relatively lower, with only 26% of adolescents spending more than 4 hours per day, 41% spending 2–4 hours, and 33% spending 1–2 hours on educational platforms.

Objective 2 studies the digital overload in terms of digital engagementamong adolescents. The percentage distribution is given in the following table in terms of agreement with the statement.

Table 2: Percentage distribution of digital overload- digital engagement among adolescents

Sno.	Items	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1	I feel constantly pressured to reply to messages on my phone.	7.2	18	36	31.5	7.2
2	I feel constant urge to post stories/photos on my social media.	8.1	8.1	28.8	32.4	22.5
3	I feel the need to constantly check my phone even when I don't get any notifications.	15.3	44.1	21.6	15.3	3.6
4	It feels like I don’t have anything to do when I don’t have my phone with me.	9.0	22.5	26.1	27.9	14.4
5	I am unable to detox from my phone even when I know I need to.	14.4	24.3	25.2	28.8	7.2

6	I feel overwhelmed by large number of notifications I receive.	9.0	31.5	18	34.2	7.2
7	I feel frustrated when my internet is slow/lagging.	32.4	43.2	18	4.5	1.8

The responses in table 2 reveal that a considerable proportion of teenagers experience symptoms associated with digital overload.A moderate level of agreement was observed for feeling pressured to reply to messages promptly, with 25.2% of respondents agreeing or strongly agreeing. Only a small proportion (16.2%) strongly agreed or agreed that they feel compelled to post stories or photos on social media, while a large segment (54.9%) remained neutral or disagreed.A striking finding is that 59.4% of respondents agreed or strongly agreed that they check theirphones even without notifications.About 38.7% reported difficulty in taking a digital detox despite agreeing on its necessity whereas almost 25% percent were neutral about it.The perception of being overwhelmed by numerous notifications was also common, with 40.5% agreeing or strongly agreeing. The most prominent indicator of digital dependency emerged in responses to slow internet connections, where 75.6% expressed frustration.

Objective 3 studies the relationship between digital overload and cognitive fatigue among adolescents. Coefficient of correlation was calculated in the following table.

Table 3: Correlation between digital overload and cognitive fatigue among adolescents

Variable	N	M	SD	r	Level of significance
Digital Overload	110	21.80	4.601	.528	.01
Cognitive Fatigue	110	22.95	5.628		

Table 3shows the mean and standard deviation values of digital overload and cognitive fatigue among adolescents. The mean values are 21.80 and 22.95, respectively, for digital overload and cognitive fatigue where whereas the standard deviation values are 4.601 and 5.628, respectively. The coefficient of correlation value is .528, which is significant at the .01 level. Hence, the hypothesis,' there is no significant correlation between digital overload and cognitive fatigue among adolescents,' may not be accepted. The coefficient of correlation value is positive, which means that the more digital overload experienced by the adolescents more will be the cognitive fatigue.

Results and discussion

The findings from table 1 and table 2 collectively highlight a considerable degree of digital engagement which translates into varying levels of perceived digital overload among the adolescents.

Table 1 presents the patterns of digital device usage across different online activities. The data indicate that the majority of adolescents (71.2%) spend at least 1–2 hours daily on messaging and chat applications such as WhatsApp, Discord, and Snapchat, while nearly half (45.9%) spend 2–4 hours on social media platforms like Instagram and Twitter. This shows that social media consumes a relatively larger portion of adolescents' digital time compared to other activities, possibly due to its highly interactive and socially rewarding nature. On the other hand, academic use of digital platforms remains moderate, with 41.4% using them for 2–4 hours daily.

The high usage of streaming and social media platforms indicates that adolescents rely heavily on digital media for leisure and social interaction. It also contributes to cognitive overload significantly, as the constant flow of information and multitasking across platforms demands continuous attention and processing. This aligns with prior studies (e.g., Tafesse et al., 2024; Smith et al., 2021), which observed that extended digital exposure tends to deplete mental resources and impair sustained focus.

Table 2 captures adolescents' subjective experiences of digital overload. A notable portion of respondents reported behaviors indicative of compulsive digital engagement: 59.4% either agreed or strongly agreed that they feel the need to check their phones even without notifications, and 56.7% expressed frustration when their internet is slow. These responses indicate heightened dependency on digital connectivity, which reinforces feelings of urgency and restlessness associated with digital overload. Similarly, nearly 40% of adolescents admitted difficulty in detoxing from their phones despite recognizing the need.It shows internal conflict between awareness of digital fatigue and the inability to regulate usage.

The perception of being pressured to respond to messages (25.2% agree or strongly agree) and the feeling of being overwhelmed by numerous notifications (40.5%) further reflect the social and cognitive demands imposed by continuous digital interaction. Such pressures may lead to attention fragmentation and mental exhaustion, key elements of cognitive fatigue. The tendency to feel idle without a phone (31.5% agree or strongly agree) also suggests that digital connectivity has become deeply ingrained in adolescents' sense of activity and self-regulation.

Also the study reveals a significant positive correlation between digital overload and cognitive fatigue among adolescents ($r = .528$, $p < .01$). The constant exposure to digital content, multitasking across multiple platforms, and the persistent need to stay connected put considerable strain on their cognitive resources, leading to mental exhaustion and drained cognitive resources.

The result supports previous research indicating that excessive digital engagement can overwhelm an individual's cognitive system, reducing efficiency in information processing and impairing focus and memory functions (Li etal., 2023 and EugéniaCorreia de Barros 2024). These findings also resonate with recent research emphasizing the cognitive costs of constant connectivity (Karim et al., 2024).

Conclusion

The results from the present study suggest that digital overload among adolescents involves not only the quantity of time spent on digital activities but also the psychological compulsion and stress associated with constant connectivity. The coexistence of high digital usage and perceived overload points toward a pattern where adolescents' excessive engagement with technology contributes to increased cognitive fatigue. It emphasizes the need for awareness and interventions that promote balanced digital habits and mindful engagement with technology.

References

Barros, Eugénia. (2024). Understanding the Influence of Digital Technology on Human Cognitive Processes: A Review. 10.20944/preprints202404.1844.v1.

Hasan M. K. (2024). Digital multitasking and hyperactivity: unveiling the hidden costs to brain health. *Annals of medicine and surgery (2012)*, *86*(11), 6371–6373. https://doi.org/10.1097/MS9.0000000000002576

Holtzer, R., Shuman, M., Mahoney, J. R., Lipton, R., &Verghese, J. (2011). Cognitive fatigue defined in the context of attention networks. *Neuropsychology, development, and cognition. Section B, Aging, neuropsychology and cognition*, *18*(1), 108–128. https://doi.org/10.1080/13825585.2010.517826

Karim, E., Pavel, H. R., Nikanfar, S., Hebri, A., Roy, A., Nambiappan, H. R., Jaiswal, A., Wylie, G. R., &Makedon, F. (2024). Examining the Landscape of Cognitive Fatigue Detection: A Comprehensive Survey.*Technologies*, *12*(3), 38.https://doi.org/10.3390/technologies12030038

Li, K., Jiang, S., Yan, X., & Li, J. (2023). Mechanism study of social media overload on health self-efficacy and anxiety. Heliyon, 10(1), e23326.https://doi.org/10.1016/j.heliyon.2023.e23326

Ma, X., Liu, Q., & Zhang, W. (2025). The impact of multidimensional excessive social media use on academic performance: the moderating role of mindfulness. Frontiers in psychology, 16, 1579509. https://doi.org/10.3389/fpsyg.2025.1579509

Ophir, E., Nass, C., & Wagner, A. D. (2009).Cognitive control in media multitaskers.*Proceedings of the National Academy of Sciences of the United States of America*, *106*(37), 15583–15587. https://doi.org/10.1073/pnas.0903620106

Shanmugasundaram, Mathura &Tamilarasu, Arunkumar. (2023). The impact of digital technology, social media, and artificial intelligence on cognitive functions: a review. Frontiers in Cognition.2. 10.3389/fcogn.2023.1203077.

Smith, A. C., Fowler, L. A., Graham, A. K., Jaworski, B. K., Firebaugh, M.-L., Monterubio, G. E., Vázquez, M. M., DePietro, B., Sadeh-Sharvit, S., Balantekin, K. N., Topooco, N., Wilfley, D. E., Taylor, C. B., & Fitzsimmons-Craft, E. E. (2021). Digital Overload among College Students: Implications for Mental Health App Use. *Social Sciences*, *10*(8), 279.https://doi.org/10.3390/socsci10080279

Subardjo, RatnaYunita& Khan, Zeeshan. (2025). Multitasking in the Era of Constant Connectivity: A Cognitive Analysis of Its Costs on Mental Performance and Well-Being. Advances in Psychological Sciences and Applications. 1. 23-31. 10.56741/apsa.v1i01.991.

Tafesse, W., Aguilar, M. P., Sayed, S., & Tariq, U. (2024). Digital Overload, Coping Mechanisms, and Student Engagement: An Empirical Investigation Based on the S-O-R Framework. *Sage Open*, *14*(1).https://doi.org/10.1177/21582440241236087 (Original work published 2024)

Wang, Xin& Zhao, Xuanzhu& Yu, Changsheng. (2025). The influence of information and social overload on academic performance: The role of social media fatigue, cognitive depletion, and self-control. Revista de Psicodidáctica (English ed.). 30. 500164. 10.1016/j.psicoe.2025.500164.