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STUDENT WELLBEING IN THE DIGITAL AGE: A REVIEW ON EXAMINING REMOTE LEARNING'S IMPACT ON MENTAL HEALTH AND ENGAGEMENT AMIDST COVID-19

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ABSTRACT

Introduction The COVID-19 pandemic necessitated a rapid transition to remote learning, which introduced the significant issue of digital fatigue among students. This article aims to explore how digital fatigue affected students' mental health and engagement throughout the pandemic.

Material and Methods The research involved a comprehensive review of academic papers published between 2020 and 2025, sourced from PubMed and Google Scholar.

Aim Remote learning significantly increased students' screen time, leading to digital fatigue, characterized by exhaustion, decreased motivation, and concentration difficulties. Contributing factors included excessive screen exposure, technology overload, and limited social interaction. The consequences observed were detriment to mental health and a decline in academic engagement.

Summary Studies consistently report high levels of digital fatigue among students, primarily driven by prolonged screen time and technology overload. This fatigue is linked to reduced engagement, lower motivation, and heightened stress and anxiety. To counter these negative effects, strategies promoting breaks and balance in online learning are recommended. Further research is essential to understand the long-term impacts and the efficacy of various interventions. This article also emphasizes the importance of personalized approaches to online education, acknowledging individual differences in managing digital fatigue. It underscores the vital role of educators and institutions in fostering supportive environments that enhance student resilience and overall well-being. The findings highlight the need for integrated strategies—combining technological, psychological, and social interventions—to effectively address the challenges of digital fatigue.

KEYWORDS

Digital Fatigue, Zoom Fatigue, Distance Learning, Mental Health, Digital Wellbeing

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1. Introduction

When schools and universities around the world closed their doors in March 2020, no one expected that ordinary computer screens would become the only window to education. The COVID-19 pandemic forced a revolution that, instead of taking years, happened in days. Students, teachers and parents found themselves in a reality where lessons took place via MS Teams, Zoom or Skype, assignments were sent via Google Classroom, and breaks between classes were filled with notifications from instant messengers like Messenger. Health safety issues in the context of the infectious disease that the SARS-CoV-2 virus causes became so serious that this experiment, initially seen as a temporary solution, evolved into a permanent remote learning model then evolving into a hybrid version. (1,2) Without a doubt, both methods of learning have left their mark in the form of digital fatigue - a syndrome that is now being referred to as the "silent epidemic of the post-pandemic era." (1)

Digital fatigue isn't just eye pain after hours spent in front of a monitor. It's a multidimensional crisis that includes cognitive overload, emotional apathy and physical exhaustion. As Stanford University researchers note, as early as 2021, "Zoom fatigue" became the subject of analysis by psychologists, who indicated that virtual meetings require more mental effort than traditional interactions. (2) Participants must constantly monitor their on-screen image, interpret limited non-verbal cues (e.g., lack of eye contact) and deal with technical distractions - all on a single monitor. (3)

2. Results

A. Classification of symptoms

Digital fatigue cannot be unambiguously presented as a homogeneous phenomenon. Symptoms extracted with the issue of zoom fatigue can be classified into five interdependent layers, which, interpenetrating each other, form the specifics of the affected person and significantly affect mental health and educational abilities - such dynamics, in which the multilayered nature of the digital fatigue phenomenon lies in the interplay of processes is shown in the following graphic (Diagram 1).

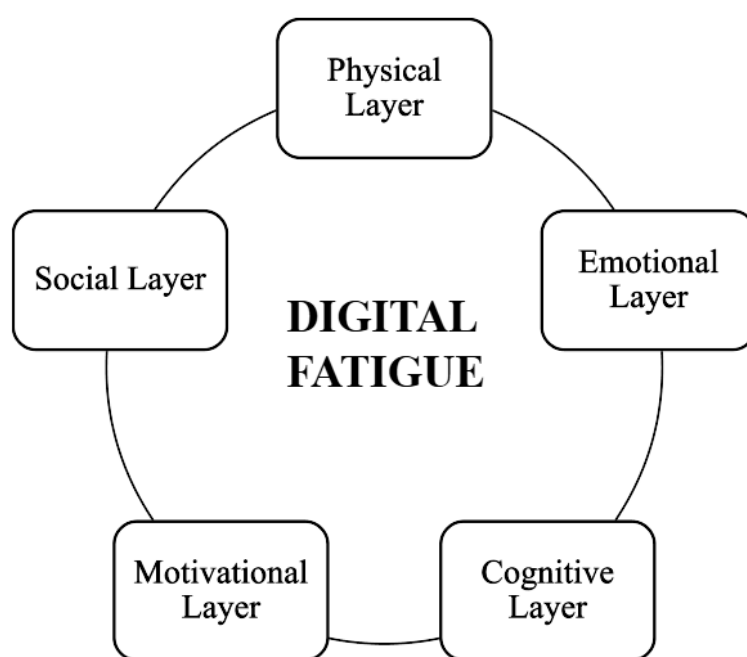


Fig. 1. Dynamic classification of symptoms

Physical layer

Prolonged staring at monitors leads to computer vision syndrome (CVS). The American Optometric Association views this phenomenon as the result of excessive use of screens, which leads to a strain on close-up vision. It is characterized by dry eyes, excessive tearing and disorders of accommodation. There are also symptoms from other systems manifested as headaches, shoulder and neck pain.(4) A meta-analysis conducted in 2023 and analyzing 103 cross-sectional studies with a total of 66,577 participants sets the prevalence of the phenomenon in the general population at 69.0%, while noting that it is among women (71.4%) that the phenomenon occurs more often than in men (61.8%). An important finding for the student population is that digital fatigue is most common among university students-76.1%.(5)

Emotional layer

Virtual classrooms, though filled with avatars of students, have proven to be spaces of profound isolation. (32) The issue of changing relationship dynamics from the previous one based on both digital technologies and frequent "live" contact has shifted significantly towards online technologies. A cross-sectional study conducted during the second lockdown on a group of 261 students illustrates the scale of the phenomenon - only 10.7% of respondents did not feel lonely. The rest of the respondents reported varying degrees of forms of loneliness. (6) The aforementioned phenomenon is not without consequences for psychological well-being- loneliness is an inflammatory factor for chronic stress, anxiety, depression and may be a potential risk factor for suicide. (7,8) It is also a risk factor for cardiovascular, metabolic and neurological diseases.(9)

Cognitive layer

COVID-19 infection itself correlates not only with subjectively perceived cognitive deficits, but also with persistent objectively measurable cognitive impairments over time - particularly those related to executive control. In addition, the study observed previously undescribed differences in the hemodynamic responses of the anterior prefrontal cortex during mental task performance in subjects who had undergone coronavirus infection, compared to a control group without a history of COVID-19. (10) In a remote learning environment, where an e-learning platform and group chat are open at the same time, the aforementioned symptoms can occur even without the coexistence of infection. Overexposure to screens contributes to reduced integrity of white matter pathways, which are crucial for reading or language processes. (11) In addition, it has been noted that tasks that rely on Internet searches, which form the basis of homework or online class activities, associated with a decrease in regional homogeneity, functional connectivity and synchronization in areas like the temporal curve, which is responsible for long-term memory. (12) Undoubtedly, during remote learning, there is increased access to attention-absorbing content and is the cause of cognitive fatigue and decreases perceptions of reality. (13, 14)

Motivational layer

When describing the motivational layer, it is worth understanding that at its core is the theory of self-determination. (15) Motivation plays a key role in the educational process, influencing students' decisions about what content, methods and timing they choose to learn. Individuals with strong motivation not only undertake challenging tasks with enthusiasm, but also actively engage in knowledge acquisition and experiment with a variety of learning techniques. (16) As a result, they achieve higher results, exhibit persistence in pursuit of goals and innovative approaches in assimilating information. The immediate and unexpected transition to remote learning creates the need to analyze the internal and external factors on which students relied. Because of the forced one-on-one work in the student-computer relationship, it began to be noticed that more importance began to be given to intrinsic factors. (17) With the phenomenon of digital fatigue, reward mechanisms and hitherto important external factors eroded. (18) An attempt was made to strengthen traditional external regulators - such as grades, deadlines or institutional pressure - as mechanisms to compensate for the lack of direct social interaction. Unfortunately, at the same time, there has been a decline in the effectiveness of rewards based on social recognition (such as teacher praise in the classroom), which have lost credibility and emotional impact in the virtual environment. (19) Intrinsic factors, which are defined which an individual manifests when performing an activity for sheer satisfaction, began to play a greater role. They involve ambition, aspirations, awareness, competence. (20,21)

A study to assess students' motivation for remote learning came to the conclusion that it was most likely due to strong intrinsic motivation that students' commitment did not change despite the teaching method. (22, 23)

Social layer

Young people, for whom the university was not only a place of learning but also a laboratory for social interaction, were suddenly deprived of the opportunity to practice empathy, resolve conflicts or build friendships. (24, 25) The impact of digital fatigue on students' social relationships is significant and multifaceted. Prolonged use of digital tools for educational communication led to fatigue, which negatively affected the quality of social interactions. (2, 26) Online contact, although it enabled the maintenance of ties in isolation, could not fully replace face-to-face, physical encounters, resulting in feelings of loneliness and alienation. (16, 27) Digital fatigue resulted in decreased engagement in conversations and social activities, and increased frustration and apathy towards social interactions in the digital environment. (28,29) As a result, interpersonal relationships were weakened, and young people found it difficult to build and maintain close relationships, leading to increased social distance and negatively affecting their psychological well-being. (25, 30)

B. Strategies to overcome digital fatigue

Individual strategies

With digital fatigue on the rise, students can implement a number of measures to reduce the negative effects of prolonged technology use. Regular breaks from the screen, a so-called "digital detox" that involves consciously limiting the amount of time spent online and introducing physical and relaxation activities between classes, are key. (2) Scheduling the day to include blocks of work and rest also proves helpful, reducing cognitive overload and improving concentration. It is also worthwhile to take care of the ergonomics of the workstation, proper lighting and sleep hygiene, which are important for overall psychophysical well-being. (4) Studies emphasize that actively seeking social contact, even online, and cultivating relationships with family and friends can alleviate feelings of isolation and loneliness. (6) It is also important to develop digital competencies that allow more efficient use of educational tools and better management of technological stress. (13)

Institutional strategies

Actions taken by universities and educational institutions play an equally important role in the fight against digital fatigue. The literature emphasizes the importance of monitoring the level of digital fatigue among students and implementing prevention and intervention programs. (24) Universities should promote a culture of openness and mutual support by organizing support groups, digital hygiene workshops and training in effective online communication. (21, 35) It is also advisable to introduce flexible forms of credit, limit the number of mandatory video conferences, and allow students to choose the form of class participation (e.g., asynchronous learning materials). (27) Institutions can also support students by providing access to psychological support, mentoring, and integration initiatives that help rebuild and maintain interpersonal relationships. (6, 25, 29) Finally, clear rules for using digital tools and promoting empathy and active listening in virtual environments foster a positive atmosphere and counteract social exclusion. (24)

3. Discussion: research gaps and future directions

Despite a growing body of research on digital fatigue and its impact on students' mental health and social relationships, significant research gaps remain. In particular, there is a lack of long-term analyses of the effects of chronic digital fatigue and research on the effectiveness of various intervention strategies. (33) Individual differences, such as the influence of demographic, personality or cultural factors on digital fatigue susceptibility and coping strategies, also remain insufficiently understood. (5, 33) Future research should also consider the impact of returning to hybrid or inpatient learning on the recovery of social relationships and the long-term consequences for student well-being. (34) Qualitative research is advisable to better understand students' subjective experiences and adaptive mechanisms in the digital learning environment. (31)

4. Conclusions

Digital fatigue is not limited to physical symptoms such as eye pain or headaches. It's a complex problem that also includes emotional exhaustion, decreased motivation, difficulty concentrating, and deterioration of social relationships. (2, 5, 6, 12, 13) Many students experienced feelings of isolation and loneliness, and their engagement in learning and satisfaction with interpersonal interactions decreased markedly. (6)

Key factors contributing to digital fatigue include excessive time spent in front of a screen, technology overload, lack of variety of stimuli, and reduced face-to-face interactions with other people. (2, 5, 24) Virtual communication, while allowing students to continue their studies and keep in touch, could not replace the richness and spontaneity of face-to-face relationships. (25, 29) As a result, many students reported not only learning difficulties, but also increased stress levels, anxiety and symptoms of lowered mood. (6, 25)

Digital fatigue has become one of the major challenges of remote education, negatively affecting students' mental health and social relationships. (1, 2, 5) Important measures to mitigate the effects of digital fatigue include regular breaks from the screen, promoting offline activities, psychological support, and developing social skills in the digital environment. (12, 13) Universities should actively engage in monitoring student well-being, implementing support programs, and creating spaces to build and maintain interpersonal relationships. (24, 25) Further research into the long-term effects of digital fatigue and the effectiveness of interventions is recommended, as is consideration of individual student needs and preferences in the design of the educational environment. (31)

Authors' contributions:**Conceptualization:** [PK]**Methodology:** [DK]**Software:** [JK]**Check:** [JK]**Formal analysis:** [IK]**Investigation:** [MJ]**Resources:** [MC], [JB]**Data curation:** [JJ]**Writing-rough preparation:** [DK]**Writing-review and editing:** [PKa]**Visualization:** [MR]**Project administration:** [JJ]**Supervision:** [PK], [JK]

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