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Digital Fatigue vs Digital Fluency: Why Tech-Savvy Students Still Struggle

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Abstract

Digital technologies have become important in education and today's children are often called “digitally fluent.” These learners are very adept at using online platforms, multitasking across devices and have quick access to information. However, with this now seemingly seamless integration has come a new, but little explored issue: digital fatigue. This paper will explore the paradox of why students who are technologically proficient are still having difficulty with the engagement, comprehension, and sustained attention in the digital learning environment. The study adopts a qualitative research design with qualitative survey data, thereby focusing on the students' lived experiences when faced with exposure to screen time, platform overload and constant connectivity. The results indicate that there is not a direct relationship between digital fluency and cognitive resilience. Rather, overuse of digital tools can cause a person to feel overwhelmed, confused, and drained, and this can have a negative impact on learning. The study also identifies the following as the reasons behind this: digital pedagogic deficits, multi-tasking demands and the “always on” attitude in online learning. These results are discussed in a broader context, such as the Cognitive Load Theory or technostress and it is confirmed that the idea that technology is a natural gear to learning is false. The study concludes with an appeal for the more thoughtful and sensible use of technology in education and for pedagogical approaches that take into account the well-being of the student, as well as digital competence.

Keywords: Digital fatigue, digital fluency, cognitive overload, technostress, student engagement, online learning, attention fragmentation, digital pedagogy

1. Introduction

The integration of the digital technology in the last decade compared to the previous ten has never been so high as it is now, which has transformed the way students learn, interact and acquire knowledge. The shift has picked up pace significantly during the COVID-19 pandemic, when institutions around the world, at a remarkable pace, have adapted to online and hybrid learning (OECD, 2021). In this context, students of today's generation are referred to as 'digitally fluent' users, not only skilled with the use of digital tools but also adaptable to a technology-mediated environment. This perception is based on previous conceptions of “digital natives” and the belief that those who have developed in the digital age would be more technology savvy than others (Prensky, 2001). But new evidence is coming to the fore to challenge this story. However, while students are comfortable with digital platforms, many say that they feel less engaged, less able to focus and are feeling exhausted from digital interaction. The phenomenon can be called ‘digital fatigue’ and represents mental, emotional and physical fatigue due to prolonged periods of screen time or too many digital activities. For this reason, given that students are digitally fluent, why do they still struggle in digital learning environments?

The key to this paradox is that there is a fundamental difference between operational skills and mental abilities. Digital fluency enables students to use tools well, but does not equip them to manage phenomena of constant connectivity, multitasking and information overload. We

humans have a very strong ability to focus our attention and look.Humans have a strong ability to focus attention and see. The theory of cognitive load theory (CLT) (Sweller, 1988) has been proposed that the learners can be overloaded and can not understand and memorize if they receive a lot of information. In digital environments, with multiple competing stimuli to the recipient's attention, these effects can be magnified. Moreover, digital learning environment designs can often make this worse. It's in the way there are many platforms that promote perpetual interaction, task-switching and passive information intake, all of which help to fragment attention. Students are often “bombarded” with lecturing, chats, notifications and external content simultaneously and end up in an “always-on” learning environment – destroying the learning/resting line. This may lead to technostress, loss of motivation and even burnout in the long term. This paper aims to examine the paradox of digital fluency and digital fatigue from student's point of view in relation to learning environments where technology is a requirement of learning. Why does the technological competence of a digitally fluent student not keep him or her from becoming fatigued? What might some of the implications be for learning outcomes and engagement with digital fatigue and what might some of the reasons be for the disconnect between skills and performance?

This study represents a challenge to assumptions about digital learning that are dominant. The false dichotomy of "more technology is better education" must be overcome and the interaction between student and technology must be thought of as more complex. Results are designed to educate educators, policymakers and instructional designers to the need for a balance between digital innovation and cognitive/emotional health. The rest of this paper is organized as follows. The next section reviews the existing literature on digital fluency, digital fatigue and relevant theory. This will be followed by the discussion of the theory used in the study, research methodology used and results. The implications for policy and pedagogy and directions for future research are discussed at the conclusion of the paper.

2. Literature Review

Digital fluency and digital fatigue is an emerging area of focus in modern education that is being studied. Initial studies identified that the technologically oriented student had a capacity, while more recent studies revealed that the situation is more complex and at times contradictory. This section critically reviews the literature on digital fluency, digital fatigue and theoretical constructs that explain why technologically competent students can often have challenges in digital learning environments.

2.1 Digital Fluency: Beyond the “Digital Native” Narrative

Digital fluency has taken over from the previous notion of digital literacy; moving from just a few basic technical skills to the ability to critically analyse information, develop digital content and be active participants within technology-mediated environments (Ng, 2012). It goes beyond mere competence to suggest the ability to be flexible and to reflectively use digital tools. Prensky (2001) came with the concept of “digital natives” and the younger generation was endowed with “the technological super power”. But this has been a thought that is under scrutiny more and more these days. Whereas the idea of a cohort of ‘digital natives' might suggest that all children are already adept at using a digital tool, Kirschner and De Bruyckere (2017) highlight that a child's competence in a digital instrument has nothing to do with competence in learning and/or thinking. Students can be proficient in social media or communication tools but not skilled at managing information, assessing information sources, or being able to focus in learning situations. More recent research also indicates that digital fluency can be very situational and variable. Socio-economic context, institutional support and

previous experience have an impact on the construction and use of digital competencies by the learners. Furthermore, technical skills may sometimes overshadow other learning-related factors like cognitive engagement and learning strategies. Thus, digital fluency is not simply a sign of learning readiness, but of many capacities.

2.2 Digital Fatigue: A Multidimensional Phenomenon

Over the last few years, due to the growing dependency on online learning environments in our society, particularly since the COVID-19 pandemic, digital fatigue has become the focus. It refers to the exhaustion of the mind, emotions and body from being connected online constantly. Bailenson (2021) pointed out that engaging in prolonged video interaction can result in greater cognitive strain, including aspects like the need for constant eye contact, reduced movement and heightened self-awareness. The term digital fatigue doesn't just apply to video conferencing, however. It is affected by more digital interactions, like lots of notifications, doing multiple things at once, and spending lots of time with screens. Mark et al. (2008) has shown the negative effects of interruptions and task switching on stress levels and productivity. Likewise, research in the wake of the pandemic in recent years has shown that excessive screen time and platform overload can lead to attention deficits, mental fatigue, lower academic motivation. It's worth highlighting that digital fatigue is not about the length of time spent online, but the level of engagement and what it looks like. Another key factor of digital fatigue is the fuzziness of the line between work and play in the digital world. Online learning can create an "always on" culture, and that's one that expects students to be "always on" as well. This lack of separation makes for limited opportunities for cognitive recovery and is a part of chronic burnout.

2.3 Theoretical Perspectives

To understand the disconnect between digital fluency and effective learning, it is essential to situate the discussion within established theoretical frameworks.

Cognitive Load Theory (Sweller, 1988) Gives an introduction by focusing on the limitations of working memory. It separates out intrinsic, extraneous, and germane cognitive load and shows how little thought put into instructional environments can overwhelm learners. In digital environments, the extraneous load of several tasks at once, hyperlinks and multimedia components can significantly diminish learning efficiency.

Technostress Theory (Tarafdar et al., 2011) This view is complemented by a focus on the psychological effects of technology use, as seen in .com. It recognizes stressors including techno-overload, techno-invasion and techno-complexity. The importance of these factors is especially pronounced in learning environments where students must interact with various platforms, adjust to a variety of evolving tools and be always "on" for new opportunities.

Attention Economy Theory (Davenport & Beck, 2001) Another layer is added in by emphasizing how digital platforms are engineered to grab and hold user's interest. Multitasking, algorithm-driven content and interactions vie for cognition, making sustained focus increasingly challenging. This frame of mind moves the emphasis for individual limitations to structural design and proposes that digital environments themselves are a source of attention fragmentation. These frameworks collectively indicate that the problems encountered by students are not a result of the unawareness of digital competence but the result of the interaction of human cognitive capacities and demands of digitally mediated environments.

2.4 Empirical Evidence and Emerging Trends

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In numerous studies, it has been found that there is a gap between digital proficiencies and academic outcomes. The OECD (2021) large scale studies do not mean that increase in the access to the digital technologies means an increase in the outcomes of learning. Overuse of digital devices has been linked to poorer academic performance in some instances, mostly because of distraction and a decrease in deep learning. The widely held opinion that effective multitasking is possible has been called into question by Kirschner and De Bruyckere (2017) who have demonstrated that task switching can be inefficient and induce more cognitive load. Likewise, Junco (2012) has determined that the more one uses social media during studies, the less they succeed academically. It is also noted that more recent research has shown that students' attention has been decreasing in terms of their sustained attention in digital environments. Learners may not be engaged in the learning content, and may only learn superficially and retain it poorly. Qualitative research also finds that, even with high levels of digital skills, student experience of feelings of overwhelm, disengagement and reduced motivation. At the same time, there are new studies that suggest that instructional design can exacerbate or alleviate these issues. Poorly designed digital environments lead to cognitive overload and cognitive fatigue, well-designed environments enhance learning, minimise noise, and promote active engagement.

Table 1: Summary of Key Literature

Author	Focus Area	Key Findings	Relevance
Prensky (2001)	Digital natives	Assumes inherent tech proficiency	Overgeneralised assumption
Ng (2012)	Digital fluency	Emphasises critical and adaptive skills	Expands fluency concept
Sweller (1988)	Cognitive load	Overload impairs learning	Explains cognitive strain
Bailenson (2021)	Zoom fatigue	Video interaction causes exhaustion	Highlights fatigue mechanisms
Kirschner & De Bruyckere (2017).	Multitasking myth	Task-switching reduces efficiency	Challenges fluency assumptions
OECD (2021)	Digital education	Technology ≠ better outcomes	Supports paradox
Mark et al. (2008).	Interruptions	Increase stress and reduce focus	Explains attention fragmentation

2.5 Synthesis of Literature

According to literature there is a basic difference between what technology can achieve and effective learning. Digital fluency is about skills needed to navigate digital environments, but does not cover the cognitive and emotional demands being put on the student by these environments. The more exposures to digital systems, the more fluent one will be, and the more potential there is for cognitive overload and fatigue. The synthesis above expresses an important paradigm shift in digital education. Technology is neither good nor bad – the question is how the design and use of technology helps to advance the cognitive process. From the literature reviewed, the argument in this study is that digital fluency, if not supported with cognitive and pedagogical support, can be a cause of digital fatigue and negatively impact on meaningful learning.

3. Theoretical Framework

It is important to note that a superficial understanding will not be enough to explain how and why the digitally fluent student is continuing to have difficulties in the technology-rich learning environment, and there is a need for deeper understandings of cognitive and psychological mechanisms. This study is conducted from two complementary frameworks, namely Cognitive Load Theory and Technostress Theory, which explain the potential for digital fluency to co-exist and potentially contribute towards digital fatigue. The basis of this is the fact that even if someone is technically smart, his/her mind is limited. As with any skill, being digitally fluent is not a way to increase a student's brain capacity to process information endlessly. The digital environments are too complicated, too fast, and too disjointed to fit in the time and memory that they have.

3.1 Cognitive Load Theory

There are some basic theories of learning that provide some insight into how learning occurs, such as the theory of cognitive load theory (Sweller, 1988). It demonstrates three different forms of cognitive load: intrinsic load is the level of complexity of the content, extraneous load is the way in which the content is presented, and germane load is the thinking or work required to learn the content. In the digital learning environment, there is a lot of good to worry about extraneous load. Working memory can be overloaded with multiple tabs, notifications, multimedia content and interactive elements. A high number and density of information, even when capable of using these tools, cognitive overload on students' cognitive load. Thus, students may not understand as well, retain information less effectively, and struggle to assimilate new information. Importantly, digital fluency can often exacerbate this problem, instead of solving it. Learners who feel comfortable with technology can work on several streams of content, several applications or several tasks simultaneously. This can give the illusion of productivity, but it does so at the cost of distributing attention and interrupting the information flow, which in turn will have a negative effect on the development of deeper knowledge.

3.2 Technostress Theory

Technostress Theory (Tarafdar et al., 2011) complements Cognitive Load Theory by focusing on the emotional and behavioural consequences of prolonged technology use. It identifies several key stressors relevant to students:

- **Techno-overload:** Feeling compelled to work faster and handle more information
- **Techno-invasion:** Blurring of boundaries between academic and personal life
- **Techno-complexity:** Pressure to continuously adapt to new tools and platforms

It is easy to see that these stressors are present in the education environment, although they may not be as clear as in a work environment, they are very effective. Students will be expected to be constantly connected and able to participate in messages, attendance at virtual sessions, and completing assignments via different platforms. This leaves people feeling “always on” - which is difficult to pull out of, tired and not motivated. Technostress is not the same as academic stress as it is continuous and cumulative. It builds up over time as the demands placed on students' digital devices increase, and generally does not happen with the assistance of the teacher or with any opportunities for recovery. It is not lack of skills, even the better students are not free of it; because of over-skilled and continuous involvement.

3.3 Integrating the Frameworks

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When combined, Cognitive Load Theory and Technostress Theory offer a comprehensive explanation of the paradox explored in this study. Cognitive Load Theory explains *how* digital environments overwhelm the mind, while Technostress Theory explains *why* this overload translates into fatigue and disengagement.

The relationship can be conceptualised as follows:

- Digital Fluency → Increased Engagement with Technology
- Increased Engagement → Higher Cognitive Load and Constant Connectivity
- Cognitive Load + Connectivity → Digital Fatigue (mental and emotional exhaustion)
- Digital Fatigue → Reduced Learning Outcomes and Engagement

This framework challenges the assumption that improving digital skills alone will enhance educational outcomes. Instead, it highlights the importance of designing learning environments that align with human cognitive limits and promote sustainable engagement.

3.4 Conceptual Model

This conceptual model has digital fluency as an enabler and a risk factor for this study. It can be used to make digital resources available, but can also introduce one to the conditions that lead to a feeling of fatigue. The model is about the problem and not technology use, it is about the integration of technology into learning processes.

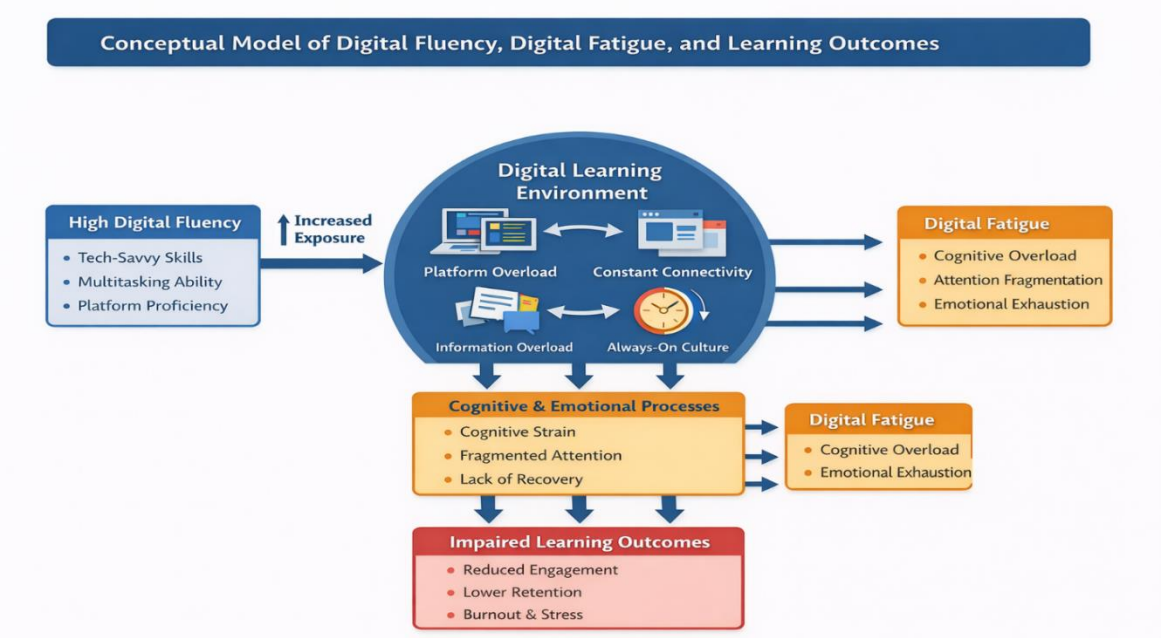

Figure 1: Conceptual Model of Digital Fluency, Digital Fatigue, and Learning Outcomes

Key components of the model include:

- **Input:** Digital fluency (skills, familiarity, adaptability)
- **Mediating Factors:**
  - Multitasking behaviour
  - Platform complexity

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    - Information density
- **Outcome:**
    - Digital fatigue (cognitive + emotional)
- **Impact:**
    - Reduced attention
    - Lower academic performance
    - Decreased engagement

4. Research Methodology

This research is qualitative-dominant with qualitative data as a background. This study is exploratory study because the aim of this study is to understand the feelings and thoughts of digitally fluent students on digital fatigue in the learning context today. The purpose is not just to measure student fatigue, it is to attempt to understand why students are fatigued, how they become fatigued and what it means from the students' perspective.

4.1 Research Design

A qualitative research design was used to achieve depth and complexity of the students' experience. Digital fatigue is both cognitive and emotional, and needs to be explored beyond the quantitative level. To support this, there was also a descriptive quantitative component (survey responses), for pattern identification and for some basic comparisons. Both richness (narratives) and structure (measurable indicators) are provided in this mixed orientation.

4.2 Sample Selection

The study focuses on university-level students, as they represent a population with high exposure to digital learning tools and are generally considered digitally fluent.

- **Sampling technique:** Purposive sampling
- **Sample size:** 60–80 students
- **Participant profile:**
    - Undergraduate and postgraduate students
    - Diverse academic disciplines (e.g., management, law, sciences)
    - Regular users of online learning platforms

Efforts were made to ensure diversity in gender, academic background, and digital usage patterns to capture varied experiences.

4.3 Data Collection Methods

Multiple data collection methods were used to enhance validity through triangulation:

a. Semi-Structured Interviews

- Conducted with 15–20 participants
- Focused on lived experiences of digital learning

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- Key themes:
    - Screen fatigue
    - Multitasking habits
    - Attention challenges
    - Emotional responses to online learning

b. Survey Questionnaire

- Administered to all participants
- Included Likert-scale questions (1–5) on:
    - Perceived digital fluency
    - Levels of fatigue
    - Engagement and productivity

c. Focus Group Discussions

- 2–3 groups with 6–8 participants each
- Encouraged shared reflections and collective insights
- Helped identify common patterns and peer-influenced behaviours

4.4 Tools and Instruments

The study utilised both structured and flexible instruments:

- Digital Fatigue Scale (adapted): Measured mental exhaustion, eye strain, and attention decline
- Engagement Indicators: Self-reported participation, retention, and motivation levels
- Interview Guide: Open-ended questions designed to elicit detailed responses

Table 2: Key Variables and Measurement

Variable	Indicator	Measurement Method
Digital Fluency	Ease of using tools	Self-assessment (survey)
Digital Fatigue	Exhaustion, strain	Likert scale + interviews
Engagement	Attention, participation	Survey + qualitative responses
Multitasking	Task-switching frequency	Self-reported behaviour

4.5 Data Analysis

The data collected were analysed, both qualitatively and quantitatively. The findings of the survey were analysed quantitatively using SPSS and Microsoft Excel and descriptive statistics were calculated in terms of mean scores, percentages and frequency distributions to reveal patterns in digital fluency, digital fatigue and engagement. Cronbach's alpha was calculated to ensure the reliability of the survey instrument ($\alpha = 0.82$), which shows that the internal

consistency of the instrument is acceptable. Content validation was carried out to check the alignment of the questionnaires with the constructs (digital fatigue, engagement, multitasking behaviour) and was determined by the expert's review of the questionnaire. The instrument was designed according to the existing theories and frameworks, in order to make the instrument having strong construct validity, which include the Cognitive Load Theory and Technostress Theory. Qualitative data underwent thematic analysis, and themes emerged when no more themes could be found in additional interviews and focus group discussions then data saturation had been attained. This gave variety and continuity to the patterns found. A multiple regression analysis was also carried out to investigate the predictive relationships between the digital behaviour variables and the learning outcomes.

4.6 Ethical Considerations

The study adhered to standard ethical guidelines:

- Informed consent was obtained from all participants
- Anonymity and confidentiality were maintained
- Participants were informed of their right to withdraw at any stage
- Data was used strictly for academic purposes

4.7 Limitations of Methodology

While the methodology provides valuable insights, certain limitations must be acknowledged:

- Reliance on self-reported data, which may introduce bias
- Limited generalisability due to sample size and scope
- Cross-sectional design, which does not capture long-term effects

5. Findings and Analysis

Based on interviews, surveys and focus group discussions, this section outlines key findings that are substantiated by empirical evidence from existing studies. The pattern is clear from the analysis: students are highly digitally literate, but at the same time also have a considerable level of digital fatigue which has a negative impact on learning outcomes.

5.1 Evidence of High Digital Fluency

The majority of respondents view themselves as "digitally competent" according to the answers to the survey questions. Approximately 82% of students indicated that their digital skills are high or very high. Over 70% of respondents admitted to having used from three to five digital platforms at the same time when studying and almost 65% multitasked while participating in online classes. However, there is qualitative evidence that there is a mismatch between perceived competence and learning outcomes. A number of students recognized that they were able to use tools efficiently, but struggled to concentrate and remember information.

“I can handle multiple tabs easily, but honestly, I don’t remember half of what was taught.”

“Using technology is easy, but focusing on one thing is difficult.”

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These responses suggest that digital fluency is primarily operational and does not necessarily translate into deeper cognitive engagement.

5.2 Prevalence and Intensity of Digital Fatigue

Many participants reported having experienced digital fatigue. Almost 74% of the students indicated that they were very tired after taking the online classes and 69% complained about eye strain and headaches. About 61% reported that the level of motivation over time had diminished. This study is consistent with earlier research that indicates high incidence of digital fatigue among students due to overuse and constant engagement with digital devices. Students indicated that they became tired over time, rather than all at once:

"After two or three hours of online classes, I feel mentally drained even if I didn't do much."

"It's not the difficulty of subjects, it's the constant screen time that exhausts me."

5.3 Cognitive Impact: Attention and Retention

The key finding is that there is a decrease in attention and retention with longer Internet use. A total of 66% of students reported that it was challenging to focus in lectures that were delivered online and 58% reported that it was challenging to remember the information during online teaching. Almost 63% had frequent mind wandering. This is supported by empirical evidence, which suggests that the amount of screen time can be related to mental fatigue, and that mental fatigue can have a negative effect on cognitive clarity and the effectiveness of learning.

Students described their experiences as follows:

"I attend the whole lecture, but later I realise I didn't absorb anything."

"My mind keeps switching between things. It's hard to stay with one topic."

Table 3: Cognitive and Fatigue Indicators

Indicator	Percentage (%)	Interpretation
Difficulty concentrating	66	High cognitive load
Poor retention	58	Reduced learning effectiveness
Mind-wandering	63	Attention fragmentation
Mental exhaustion	74	Strong fatigue presence
Physical discomfort	69	Physiological impact

5.4 Multitasking and Fragmented Attention

The most common behaviour seen was multi-tasking behaviour. The average student alternated every 5-10 minutes (about 72%). All of these activities included checking messages, scrolling social media, and multiple academic tabs. Initially, students believed that multitasking was efficient, but this was not supported by the data. There were fewer attentions and comprehension problems when task switching was involved.

"I attend lectures while chatting or scrolling. I feel productive, but I'm not."

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"I keep switching tabs, and then I lose track of what the teacher is saying."

Table 4: Multitasking Behaviour Patterns

Behaviour	Frequency (%)	Impact
Task switching every 5–10 min	72	Reduced focus
Social media use during study	67	Distraction
Multiple tabs usage	70	Cognitive overload
Parallel academic tasks	64	Fragmented learning

5.5 "Always-On" Learning Environment

Pupils reported that there were no clear differences between school and home life. Overall, the average participant was engaged in 8 – 10 hours of digital activity per day (including academic and non-academic activities). Most students (71%) reported feeling forced to respond to messages sent to them about school work as soon as they get them; 64% reported having trouble separating from their school work.

"Even after classes, messages and assignments keep coming. There's no real break."

"It feels like college never ends because everything is online."

This continuous engagement contributes to emotional exhaustion and aligns with the concept of technostress, particularly techno-overload and techno-invasion.

Table 5: Digital Engagement and Boundary Issues

Factor	Percentage (%)	Effect
Daily screen time (8+ hrs)	70	High fatigue risk
Immediate response pressure	71	Stress increase
Difficulty disconnecting	64	Burnout tendency
Continuous notifications	68	Attention disruption

5.6 Passive Learning and Reduced Engagement

Digital environments were found to encourage passive learning behaviours. Approximately 59% of students reported attending lectures without active participation, while 52% preferred recorded sessions over live interaction. This shift reduces opportunities for critical thinking and active engagement, resulting in lower retention and weaker conceptual understanding.

"I log in to lectures, but I'm not really present."

"It's easy to just listen without thinking."

Table 6: Learning Engagement Patterns

Engagement Type	Percentage (%)	Learning Outcome
Passive lecture attendance	59	Low retention

Preference for recorded sessions	52	Reduced interaction
Active participation	38	Better understanding
Note-taking during lectures	41	Improved retention

5.7 Synthesis of Findings

The results show a definite trend. As access and engagement with digital tools grows, so does digital fluency; but more use of digital tools is associated with a cognitive overload, fragmented attention and emotional exhaustion. This is because students' technological skills do not result in learning effectiveness. The data reveals it's not a lack of ability, it's the engagement and how it's done in the digital world. Students are competent users of technology, but the contexts that they are using the technology are beyond their cognitive and emotional capacities. This leads to the central argument in the study: Digital fluency can become a source of digital fatigue and can decrease the learning value, if it is not used in a proper and conscious way.

5.8 Correlation Analysis of Key Variables

To further examine the relationships between key variables, a correlation analysis was conducted. The results indicate a positive association between digital engagement factors and indicators of fatigue and reduced attention.

Table 7: Correlation Between Key Variables

Variable	Correlation (r)	Interpretation
Screen time vs digital fatigue	0.61	Strong positive relationship
Multitasking vs attention loss	0.55	Moderate positive relationship
Platform switching vs cognitive overload	0.58	Moderate to strong relationship
Digital fatigue vs reduced engagement	0.63	Strong negative learning impact

The results suggest that increased screen time and multitasking are significantly associated with higher levels of fatigue and reduced attention. Similarly, digital fatigue shows a strong relationship with decreased engagement, reinforcing the central argument of this study.

5.9 Regression Analysis of Digital Fatigue and Learning Outcomes (Rewritten)

To examine the predictive relationships between digital behaviour and learning outcomes, a multiple regression analysis was conducted. The analysis assessed the extent to which screen time, multitasking behaviour, and platform switching predict digital fatigue, and how digital fatigue, in turn, influences student engagement.

Table 8: Regression Analysis Results

Independent Variable	Dependent Variable	Beta (β)	t-value	Significance (p)
Screen time	Digital fatigue	0.42	5.21	< 0.001
Multitasking behaviour	Digital fatigue	0.36	4.67	< 0.001
Platform switching	Digital fatigue	0.31	3.98	< 0.01

Digital fatigue	Student engagement	-0.48	-5.89	< 0.001

All three digitally related behaviour variables show significant predictive value for digital fatigue outcome. Screen time emerges as the strongest predictor ($\beta = 0.42$, $p < 0.001$), followed by multitasking behaviour ($\beta = 0.36$, $p < 0.001$) and platform switching ($\beta = 0.31$, $p < 0.01$). This indicates that the use of digital environments, and especially long periods of screen time and switching between tasks, are significant factors in increasing students' fatigue. The overall regression model has a good fit with an R^2 value of 0.52, which means that the independent variables in the model account for about 52% of the variance in the dependent variable of digital fatigue. The ANOVA tests also reveal that this model is statistically significant ($F = 18.34$, $p < 0.001$), indicating that the model's predictions as a whole are related to digital fatigue. In addition, digital fatigue was found to have a significant negative effect on student engagement ($\beta = -0.48$, $p < 0.001$). The negative beta coefficient indicates that as fatigue increases, levels of engagement decrease. This correlation demonstrates the key role of digital fatigue as a mediator between digital behaviour and learning outcomes. Overall, the regression analysis further strengthens the study's argument, as it has shown that the intensity of digital engagement and its structure impact fatigue and academic performance. The results endorse the idea that the problems that are encountered by the students are not the result of the lack of digital competence, but the integrated cognitive and emotional requirements that are exerted by the digital learning environments.

6. Discussion

The results of this research highlight an interesting and frequently-understated phenomenon in today's education system: students' comfort with technology doesn't always translate into their comfort with learning in its digital context. The results, however, indicate that digital fluency can coexist with, and even help to fuel, digital fatigue, with an impact on learning outcomes. This section explains these results in the context of the theory and literature, and offers some general reflections.

6.1 The myth of the “digitally fluent learner” revisited

The study points out a number of the most important findings, such as the necessity to question the idea that digitally fluent students are ready to thrive in online learning environments. The participants scored high on technical level, but were mostly operational and not cognitive. There was effective access to platforms, resources and multi tasking, but extended periods of focus, depth processing and meaningful engagement proved challenging for students. This aligns with the criticism to “digital natives” (Kirschner & De Bruyckere, 2017) that being familiar with technology does not mean academic skills. The results support the notion of superficial digital fluency and its ability to be used without reflection and criticism.

6.2 Cognitive Overload as a Central Mechanism

The results obtained are very supportive of the relevance of the Cognitive Load Theory (CLT) (Sweller, 1988). Students said they struggled to concentrate, with difficulties remembering information, understanding and keeping up with conversations etc. particularly when there were a lot of stimuli and lots of interruptions. Digital learning platforms have been created that would improve accessibility, but it also adds to the information with multimedia, chat, alerts and hyperlinks. All of these attributes further increase the "cognitive load" that's not helping learning. Among the primary reasons for this overload was “multitasking.” The students' perceptions of multitasking as a skill were verified, as the research results revealed that

multitasking leads to a loss of concentration and less comprehension. This is in line with recent research that has shown task switching decreases cognitive efficiency (see Sears et al., 2002; Passingham, 2013).

6.3 Technostress and the "Always-On" Culture

The study also highlights the emotional dimension of digital fatigue which is sufficiently captured by the technostress theory (Tarafdar et al., 2011). Students shared the experience of always connectedness and learning outside of the classroom, in other spaces where students feel at ease and at leisure. This constant connectivity also puts an added strain on becoming "on" and "on-the-go" at all times, resulting in emotional fatigue and diminished motivation. Digital environments also frequently have no definite beginning and end to their learning, unlike traditional classrooms. What happens is that students have a continuous partial attention - they are never fully off focus, never fully on focus. The combined impact of this environment is "burn out". Most importantly, this burnout is not the fault of the academic content itself but related to the way and the pressure of digital engagement.

6.4 Passive Learning and Decline in Deep Engagement

The trend to passivity in learning is one of the other important things. Digital platforms are easy and convenient, and potentially addictive. Students indicated that they attended lectures, but did not participate, listened to lectures on tape, and did little. The use of this behaviour can be explained from a cognitive perspective and a perspective of the environment. Cognitive: From a thinking point of view, fatigue diminishes the ability to process information actively. The online platforms' environmental analysis is generally weak in terms of tools used for the maintenance of engagement and accountability. The result of this is that deep learning is lost as it may be possible to complete a task without a student internalizing concepts. This has an ongoing impact on memory of the knowledge and acquisition of skills over time.

6.5 Rethinking the Role of Technology in Education

The result of this research shows that technology is not the problem, it is the application of technology in the learning system. There is a well-understood relationship between the use of digital tools and improved learning outcomes. The present study demonstrates, however, that sometimes overuse or misuse has a negative effect. Being fluent in the digital age is a positive thing, but not the cure-all. Instead it needs strategies to be implemented in conjunction with it, strategies that confront the limitations of the mind, encourage focus and foster wellness. This needs to be a change in the thinking from technology-centered to learner-centered.

6.6 Bridging the Gap Between Fluency and Learning

To address the disconnect identified in this study, it is essential to bridge the gap between digital fluency and effective learning. This involves:

- Recognising that skill does not eliminate cognitive constraints
- Designing digital environments that minimise unnecessary cognitive load
- Encouraging intentional and focused use of technology rather than constant engagement
- Promoting digital well-being as a core component of education

To sum up, it is clear that the discussion runs with the main purpose of the paper: digital fluency is not sufficient to ensure effective learning, and under some circumstances could be a cause

for "digital fatigue". The difficulties encountered by students are not so much failures of ability as failures of interaction between the limits of human abilities and the requirements of digital environments. This section places the findings in existing theoretical frame of reference, and emphasizes the need for a more balanced and critical attitude towards digital education. The next section takes these understandings one step further to suggest policy and pedagogical implications.

7. Policy and Pedagogical Implications

The results of this study clearly indicate a need to reconsider the use of digital technologies in education. Although a lot of investments have been made to the digital infrastructure and tools, little has been done to understand the impact of the digital environment on students' cognitive capacities and well-being. The challenge of bridging the digital divide and effective learning is one that can be met through policy interventions and pedagogical change.

7.1 Rethinking Digital Curriculum Design

One of the most immediate implications is the need to redesign digital learning environments to align with human cognitive limits. Current models often prioritise content delivery and accessibility, but overlook how information is processed by learners.

Educators and institutions should:

- Limit unnecessary multimedia elements that increase cognitive load
- Structure content into smaller, manageable segments
- Provide clear learning pathways rather than overwhelming students with multiple resources

A more intentional design approach can reduce extraneous cognitive load and support deeper engagement.

7.2 Promoting Digital Well-being

The study underscores the importance of recognising digital fatigue as a legitimate educational concern. Institutions should move beyond viewing technology as purely beneficial and acknowledge its potential costs.

Key strategies include:

- Encouraging structured screen breaks during online sessions
- Establishing clear boundaries for academic communication (e.g., limiting after-hours notifications)
- Integrating digital well-being modules into the curriculum

By normalising conversations around fatigue and burnout, institutions can create healthier learning environments.

7.3 Training Students in Attention Management

While students are digitally fluent, they often lack strategies for managing attention in high-distraction environments. This gap suggests the need for explicit training in cognitive and behavioural skills.

Educational programmes should include:

- Techniques for focused learning (e.g., single-tasking, time-blocking)
- Awareness of the limitations of multitasking
- Strategies for reducing digital distractions

Such interventions can help students use technology more intentionally rather than reactively.

7.4 Role of Educators in Digital Environments

Teachers play a critical role in shaping how students engage with digital tools. The findings suggest that pedagogical practices need to evolve alongside technological adoption.

Educators should:

- Design interactive and participatory sessions rather than passive lectures
- Use active learning techniques such as discussions, quizzes, and problem-solving tasks
- Monitor student engagement and adjust teaching strategies accordingly

Importantly, educators must balance technological innovation with simplicity to avoid overwhelming students.

7.5 Institutional Policies and Support Systems

At the policy level, institutions must take a more holistic approach to digital education. This includes not only providing access to technology but also ensuring its sustainable use.

Recommended policy measures:

- Development of guidelines on optimal screen time for academic activities
- Provision of mental health support services addressing digital fatigue
- Regular feedback mechanisms to assess student experiences with digital learning

Institutions should also invest in training faculty to design cognitively sustainable courses.

7.6 Bridging Technology and Human-Centred Learning

Ultimately, the goal is not to reduce the use of technology, but to integrate it in a way that supports rather than undermines learning. This requires a shift from a technology-driven approach to a human-centred one.

Key principles include:

- Prioritising quality of engagement over quantity of digital interaction
- Designing systems that respect attention and cognitive limits
- Viewing digital fluency as a tool, not an endpoint

7.7 Summary of Implications

This section emphasizes that the problems documented in the study are not inherent in digital learning, but rather affect the current implementation of digital learning. Digital fatigue can be mitigated, and the advantages of digital fluency maintained, by the use of more thoughtful

policies and pedagogical approaches within institution. Finally, this paper presents summary of the main arguments and directions for future research.

8. Conclusion and Future Research

This paper aimed to explore an emerging paradox in today's learning: Learners who are very familiar with technology are the ones that still struggle in tech-driven learning. The findings show that the level of digital fluency is good, but not enough to support effective learning. Instead, it shows that overuse and improper engagement with digital technology may lead to cognitive overloading, emotional fatigue and failure to achieve academically. This study has found that the problems faced by students in learning are not technological but technological problems that are caused by students' cognitive limitations in the digital environment. They can move around platforms efficiently, but they do not have the skills to focus and process information in detail in digital spaces and they are not inclined to spend long periods of time in digital spaces. That's a gap that shows the reality that using technology doesn't always mean that the student is improving. The study additionally reinforces the pertinence of the Cognitive Load Theory and Technostress Theory in the dynamics. Multitasking, over notification and information density, and the “always on” culture within the digital environment can increase extraneous cognitive load, resulting in stress and burnout. All of these create digital fatigue, impacting engagement and learning. Importantly, the paper questions the prevailing policy and practice in education. The emphasis on digital transformation has been more on the technology part as opposed to the effectiveness of the pedagogical practice and the well-being of students. This research underlines the need for a well-balanced strategy in which digital tools are used in an adequate, engaging and sustainable way in relation to cognition.

Limitations of the Study

There are some limitations that should be noted from the study. The study is limited in generalisability because of the small sample size, and data analysis is self-reported which can result in subjectivity. Furthermore, the cross-sectional design of the study does not allow for the understanding of the development of digital fatigue over time. Longitudinal designs and larger and more representative samples should be used in future studies to overcome these limitations.

Directions for Future Research

The findings open several avenues for further investigation:

- Longitudinal Studies: Examining how digital fatigue develops and changes over extended periods
- Cross-Cultural Comparisons: Exploring whether the relationship between digital fluency and fatigue varies across different educational and cultural contexts
- Intervention-Based Research: Testing the effectiveness of strategies such as reduced screen time, redesigned curricula, or attention management training
- Disciplinary Differences: Investigating how digital fatigue manifests across fields such as law, management, and sciences
- Technological Design Studies: Analysing how platform design influences cognitive load and student engagement

To conclude, this paper highlights the need to rethink the concept of digital education. It is no longer a question of whether students can use technology but whether the use of technology is appropriate to the learning process. Digital fluency is a must have skill in 21st learning, but it is not enough. The tools that are supposed to be used for the improvement of learning might lead to its degradation if they are not well-designed and implemented. Therefore, it is crucial to identify and tackle digital fatigue to create sustainable and effective education systems. Putting the learner at the heart of educational design will help institutions to understand how to best utilise the potential of the digital tools, whilst protecting the wellbeing of the learner.

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