Digital Reading Fatigue as a Mediator Between Digital Reading Exposure and Reading Performance among Philippine Junior High School Students

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ABSTRACT

The increasing integration of digital technologies into secondary education has transformed students' reading practices and raised concerns regarding the cognitive consequences of prolonged screen-based reading. This study examined levels of digital reading exposure and fatigue among Grade 7 students and investigated whether digital reading fatigue statistically mediates the relationship between digital reading exposure and academic reading performance. Guided by Cognitive Load Theory, Digital Literacy Theory, and Self-Regulated Learning Theory, the study employed a quantitative descriptive-correlational design with mediation analysis. A total of 172 Grade 7 students from Bislig City National High School in the Philippines were selected through stratified proportional random sampling. Data were gathered using the researcher-developed Digital Reading Exposure Scale, Digital Reading Fatigue Scale, and the Philippine Informal Reading Inventory (Phil-IRI) posttest. Results revealed that students demonstrated high levels of digital reading exposure and moderate levels of digital reading fatigue, while most learners were classified at the instructional and frustration levels of reading performance. Significant positive relationships were found between digital reading exposure and several dimensions of digital reading fatigue. However, digital reading exposure did not directly predict academic reading performance. Mediation analysis revealed that digital reading fatigue statistically mediated the relationship between digital reading exposure and academic reading performance, indicating that the effects of digital reading exposure operate through fatigue-related cognitive, attentional, emotional, and physical processes. The findings underscore the importance of promoting digital wellness, attention regulation, and balanced reading practices to support literacy development in technology-rich learning environments.

Keywords: Digital reading fatigue; digital reading exposure; reading performance; mediation analysis; junior high school

INTRODUCTION

The integration of digital technologies into Philippine secondary education has fundamentally altered the landscape of reading and learning. Students now routinely access lessons, assignments, and academic resources through smartphones, tablets, and laptops, a shift that has expanded access to information while simultaneously introducing new cognitive demands on developing readers. For Grade 7 learners, who are at a critical stage in the transition from foundational literacy skills to higher-order comprehension and academic reading, these demands may carry important educational consequences (Sweller, 1988; Ng, 2012). As digital reading increasingly becomes embedded in classroom instruction and independent learning, understanding its influence on students' reading performance has become an educational imperative.

Existing research presents a nuanced and evolving understanding of the relationship between digital reading and learning outcomes. Studies have consistently shown that digital technologies can broaden access to educational

content, support learner engagement, and provide flexible opportunities for academic learning when used purposefully (Altamura et al., 2023; Barrot, 2021; Istiq'faroh et al., 2025). However, a growing body of literature also suggests that screen-based reading environments introduce cognitive challenges that may affect learning efficiency. Features such as hyperlinks, notifications, multitasking opportunities, and prolonged screen exposure can impose additional cognitive load, divide attention, and disrupt deep reading processes necessary for comprehension (Delgado et al., 2020; Ronconi et al., 2025; Schwartz, 2024). Consequently, recent studies increasingly argue that the educational effects of digital reading are not solely determined by exposure itself but by the cognitive and psychological conditions that accompany digital engagement. In particular, excessive screen exposure has been associated with mental fatigue, attentional difficulties, emotional exhaustion, and diminished reading performance among adolescent learners (Francisquini et al., 2024; Liu et al., 2021; Schmidt-Persson et al., 2024).

These concerns are especially significant in the Philippine educational context, where reading proficiency continues to be a national challenge. Results from the Programme for International Student Assessment (PISA) revealed that only 19.4% of Filipino learners attained the minimum level of reading proficiency, highlighting persistent difficulties in reading comprehension and literacy development among Filipino students (DepEd, 2019). The concern is particularly relevant among Grade 7 learners, who are expected to transition from basic reading competencies toward more complex academic literacy tasks that require sustained attention, inference-making, and critical comprehension. At the same time, these learners are increasingly exposed to digital learning materials both inside and outside the classroom. As a result, understanding the factors that may influence their reading performance, including the cognitive consequences of prolonged digital reading, has become increasingly important for literacy instruction and educational policy.

A critical gap in the existing literature concerns the role of digital reading fatigue as an intervening mechanism linking exposure to academic outcomes. Most Philippine studies have examined either reading habits, technology use, or screen time in relation to academic performance without adequately accounting for the cognitive and physiological processes that may explain the relationship (Abarquez, 2024; Mirasol, 2024; Barrot, 2021). Research from comparable contexts suggests that fatigue-related factors, including cognitive strain, attentional depletion, emotional exhaustion, and physical discomfort, may function as significant pathways through which prolonged digital engagement affects academic functioning (Zhuang et al., 2023; Dacillo et al., 2022; Loh & Kanai, 2022). This gap is particularly evident in provincial public-school settings such as Bislig City, Surigao del Sur, where Grade 7 teachers have observed recurring manifestations of digital reading fatigue among learners, yet empirical evidence documenting its relationship with academic reading performance remains limited.

Although prior studies have examined digital reading habits, screen exposure, and reading performance, limited empirical attention has been given to the fatigue-related mechanisms through which digital reading may influence comprehension outcomes. This gap is especially important in Philippine public secondary schools, where learners increasingly depend on digital devices while continuing to experience persistent reading difficulties. By testing digital reading fatigue as a mediator, this study moves beyond direct exposure-performance assumptions and explains how cognitive strain, attentional difficulties, emotional exhaustion, and physical fatigue may serve as pathways through which digital reading conditions influence academic reading performance. More specifically, the study contributes to the literature by empirically testing a mediation model within a public-school literacy setting, thereby providing a more comprehensive explanation of how digital reading exposure shapes reading outcomes among Filipino junior high school learners.

This study therefore sought to answer the following questions: (1) What is the level of digital reading exposure and digital reading fatigue among Grade 7 students? (2) Is there a significant relationship between digital reading exposure and digital reading fatigue? (3) Does digital reading exposure significantly predict academic reading performance? and (4) Does digital reading fatigue mediate the relationship between digital reading exposure and academic reading performance.

THEORETICAL FRAMEWORK

This study is grounded in three complementary theoretical frameworks that collectively explain how exposure to digital reading may influence academic reading performance through fatigue-related mediating processes.

Cognitive Load Theory (Sweller, 1988) serves as the primary theoretical lens. The theory posits that human working memory has a limited processing capacity, and that learning is compromised when this capacity is exceeded by extraneous cognitive demands. In digital reading environments, learners simultaneously process academic content while navigating hyperlinks, notifications, multimedia elements, and competing stimuli. These extraneous loads reduce the cognitive resources available for intrinsic (content-related) processing and germane (schema-building) processing, thereby increasing the likelihood of mental fatigue and comprehension failure (Paas & Ayres, 2014). For Grade 7 learners who are still consolidating foundational literacy skills, this cognitive burden is particularly acute (McCabe et al., 2025; Zamora et al., 2022).

Digital Literacy Theory (Ng, 2012) complements Cognitive Load Theory by emphasizing that effective digital reading requires not only technical access but also cognitive, critical, and social competencies. Learners who possess stronger digital literacy skills - including the ability to evaluate sources, manage information flow, and resist non-academic distractions - may be better equipped to navigate digital environments without incurring excessive cognitive costs (Eslit, 2023; Falloon, 2020). In resource-constrained Philippine schools, where digital literacy instruction remains uneven, many learners may be exposed to digital reading demands that exceed their current competence, amplifying fatigue-related experiences.

Self-Regulated Learning Theory (Zimmerman, 2000) provides the third theoretical pillar by explaining why learners respond differently to similar digital reading conditions. Self-regulated learners actively set goals, monitor comprehension, manage distractions, and adjust effort - behaviors that moderate the cognitive and emotional demands of screen-based reading. Learners with weaker self-regulatory capacities are more susceptible to task disengagement, attentional drift, and fatigue escalation (Panadero, 2017; Mercado & Manzano, 2024). Together, these three frameworks support the central proposition of this study: that digital reading exposure does not directly determine academic reading performance but operates through the cognitive, attentional, and physiological fatigue it generates - fatigue that mediates the pathway from exposure to achievement.

Taken together, the three theories provide a coherent explanation for the mediation model examined in this study. Cognitive Load Theory (Sweller, 1988) suggests that prolonged exposure to digital reading environments may impose extraneous cognitive demands that contribute to cognitive strain, attentional depletion, and other manifestations of digital reading fatigue. Digital Literacy Theory (Ng, 2012) further explains that learners differ in their ability to navigate, process, and manage digital information, influencing how they experience and respond to the demands of digital reading environments. Meanwhile, Self-Regulated Learning Theory (Panadero, 2017) posits that successful academic performance depends on learners' capacity to regulate attention, effort, and learning behaviors despite distractions and cognitive challenges. Drawing from these perspectives, the present study theorizes that digital reading exposure does not directly affect academic reading performance; rather, its influence operates through digital reading fatigue. Specifically, greater exposure to digital reading environments may increase fatigue-related cognitive, emotional, attentional, and physical burdens, which subsequently impair students' academic reading performance. Thus, the proposed mediation model, Digital Reading Exposure → Digital Reading Fatigue → Academic Reading Performance, represents the theoretical integration of the three frameworks underpinning this study.

METHODS

Research Design

This study employed a quantitative descriptive-correlational design with mediation analysis. The descriptive component determined the levels of digital reading exposure, digital reading fatigue, and academic reading performance among Grade 7 students. The correlational component examined the relationships among the study variables. Mediation analysis using regression-based bootstrapping was conducted to determine whether digital reading fatigue statistically mediated the relationship between digital reading exposure and academic reading performance (Hayes, 2022). Since the study utilized a cross-sectional and non-experimental design, the mediation results were interpreted as evidence of statistical mediation rather than causal relationships.

Research Locale and Participants

The study was conducted at Bislig City National High School (BCNHS), a public secondary school in Bislig

City, Surigao del Sur, Philippines. The school was selected because digital devices are regularly integrated into classroom instruction and students frequently engage in screen-based reading activities.

The target population consisted of 301 Grade 7 students enrolled during School Year 2025–2026. The sample size of 172 respondents was determined using Slovin's Formula with a 5% margin of error, a level commonly used in educational research to achieve acceptable statistical precision. After determining the required sample size, stratified proportional random sampling was employed to allocate respondents across the seven Grade 7 sections to ensure adequate representation of each section.

To be included in the study, students had to be officially enrolled in Grade 7 at BCNHS, regularly attending classes, and have access to at least one digital device used for academic or non-academic purposes. Students with documented conditions that could significantly affect reading performance and those without access to digital devices were excluded from the study. Using Slovin's Formula, a sample of 172 respondents was determined, distributed across seven class sections through stratified proportional random sampling to ensure equitable representation across all strata (Table 1).

Table 1. Distribution of Study Respondents by Section

Section	Population	Sample
Cooperative	45	26
Courteous	43	25
Devoted	43	25
Loving	43	24
Mozart	42	24
Obedient	42	24
United	43	24
Total	**301**	**172**

Note. Proportional allocation per section based on Slovin's Formula (e = 0.05).

Instruments

The Digital Reading Exposure Scale (DRES) was a researcher-developed 12-item Likert-scale instrument that measured digital use, duration of digital use, type of content accessed, and reading context and purpose. Responses were rated using a five-point scale ranging from 1 (Never) to 5 (Always).

The Digital Reading Fatigue Scale (DRFS) was a researcher-developed 15-item Likert-scale instrument that measured cognitive strain, attention control difficulties, memory and comprehension difficulties, emotional impact, and physical signs of fatigue. Responses were rated using a five-point scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

Academic reading performance was measured using the Philippine Informal Reading Inventory (Phil-IRI) for Junior High School (2024). Specifically, the Phil-IRI posttest comprehension scores were utilized as the measure of reading performance. Scores were classified as Independent (80–100%), Instructional (59–79%), and Frustration (58% and below).

Prior to data collection, the instruments underwent face and content validation by experts in educational research, language education, and educational measurement. The validators evaluated the instruments in terms of clarity, relevance, organization, language appropriateness, adequacy of content coverage, and alignment with the objectives of the study. Revisions were made based on their recommendations to improve item wording, instructions, and content alignment. Pilot testing was subsequently conducted among 30 Grade 7 students of Bislig City National High School who possessed characteristics similar to the target respondents but were excluded from the actual study. Reliability testing using Cronbach's alpha coefficient revealed good internal consistency for both instruments. The DRES obtained a reliability coefficient of 0.868, while the DRFS obtained a reliability coefficient of 0.889..

Data Collection Procedure

Prior to data collection, permission to conduct the study was secured from the Schools Division Superintendent and the School Principal. Informed consent from parents or guardians and assent from student participants were obtained before participation. The DRES and DRFS were administered online through Google Forms during a scheduled non-instructional period. The survey required approximately 10 to 15 minutes to complete. Respondents were assigned identification codes to ensure anonymity and confidentiality. Phil-IRI posttest scores were obtained from school records with proper authorization. All collected data were stored securely and were accessible only to the researcher.

Data Analysis

Data were analyzed using IBM SPSS Statistics. Descriptive statistics, including weighted mean, standard deviation, frequency, and percentage, were used to determine the levels of digital reading exposure, digital reading fatigue, and academic reading performance. Pearson product-moment correlation was employed to examine the relationships between digital reading exposure and digital reading fatigue and between digital reading exposure and academic reading performance. To test the mediating role of digital reading fatigue, regression-based mediation analysis using bootstrapping with 5,000 resamples was performed following the procedures recommended by Hayes (2022). The indirect effect was considered significant when the 95% bootstrap confidence interval did not include zero. All statistical tests were evaluated at the 0.05 level of significance..

RESULTS AND DISCUSSION

Level of Digital Reading Exposure

Table 2 presents the weighted means and adjectival ratings for the four dimensions of digital reading exposure.

Table 2. Level of Digital Reading Exposure of Junior High School Students

Dimension	Weighted Mean	Adjectival Rating
Digital Use	4.29	Always
Duration of Digital Use	3.79	Often
Type of Content Accessed	4.20	Always
Reading Context and Purpose	4.23	Always
Overall Mean	**4.13**	**Often**

Note. Scale: 4.20–5.00 = Always; 3.40–4.19 = Often; 2.60–3.39 = Sometimes; 1.80–2.59 = Rarely; 1.00–1.79 = Never.

The overall level of digital reading exposure was Often (M = 4.13), indicating that digital engagement has become a routine and deeply embedded feature of learners' academic and personal lives. Digital Use obtained the highest dimension mean (M = 4.29, Always), with the use of mobile phones for reading text messages, social media content, and school materials as the most consistently reported practices. Reading Context and Purpose (M = 4.23, Always) and Type of Content Accessed (M = 4.20, Always) were similarly high, reflecting the multimodal and multipurpose nature of students' digital reading. Duration of Digital Use was comparatively lower (M = 3.79, Often), suggesting that while digital reading is frequent, extended uninterrupted reading sessions are somewhat less consistent. This pattern implies that learners engage with digital content in shorter, more frequent bursts rather than through sustained reading sessions - a behavior associated with fragmented comprehension and increased cognitive switching costs (Delgado et al., 2020; Palma et al., 2024). The finding aligns with Altamura et al. (2023), who noted that digital engagement among adolescents is pervasive but not always academically purposeful, and with Gepila Jr. et al. (2021), who observed that Filipino students frequently accessed digital platforms for social and entertainment purposes alongside academic activities.

It is important to recognize that digital reading exposure encompasses both academic and non-academic forms of engagement. Students may use digital devices to access instructional materials, complete school tasks, and search

for educational information, while also engaging with social media content, online messaging, entertainment websites, and other recreational materials. These different forms of digital reading likely impose varying cognitive demands and may not exert identical effects on reading performance. Previous studies have shown that educational uses of digital technologies may support learning and engagement, whereas excessive exposure to non-academic digital content may increase distraction and reduce sustained attention (Barrot, 2021; Altamura et al., 2023; Ronconi et al., 2025). Consequently, the educational implications of digital reading exposure should be interpreted in relation to the nature and purpose of the reading activity rather than exposure alone.

Level of Digital Reading Fatigue

Table 3 presents the level of digital reading fatigue across five dimensions.

Table 3. Level of Digital Reading Fatigue Experienced by Junior High School Students

Dimension	Weighted Mean	Adjectival Rating
Cognitive Strain	3.41	Agree
Attention Control	3.52	Agree
Memory and Comprehension Difficulties	3.38	Neutral
Emotional Impact	3.28	Neutral
Physical Signs	3.63	Agree
Overall Mean	**3.44**	**Agree**

Note. Scale: 4.20–5.00 = Strongly Agree; 3.40–4.19 = Agree; 2.60–3.39 = Neutral; 1.80–2.59 = Disagree; 1.00–1.79 = Strongly Disagree.

The overall level of digital reading fatigue was "Agree" (M = 3.44), indicating moderate but educationally meaningful fatigue among respondents. Physical Signs registered the highest dimension mean (M = 3.63, Agree), with eye strain, headaches, and neck-shoulder tension as the most prominent manifestations. This finding is consistent with Karim et al. (2024) and Jensen et al. (2024), who documented the physiological consequences of sustained screen-based reading among adolescents. Attention Control was the second most pronounced dimension (M = 3.52, Agree), reflecting sustained difficulties in maintaining focus amid notifications, social media, and competing digital stimuli - a pattern corroborated by Loh and Kanai (2022) and Ronconi et al. (2025). Cognitive Strain (M = 3.41, Agree) completed the higher-rated cluster, indicating moderate mental overload and processing inefficiency associated with prolonged digital engagement (Sweller, 1988; Estandian et al., 2022). Memory and Comprehension Difficulties (M = 3.38, Neutral) and Emotional Impact (M = 3.28, Neutral) registered lower means, suggesting that more complex cognitive processing consequences and emotional responses were less immediately salient to learners, though not absent. The pattern is consistent with Dacillo et al. (2022) and Amboy et al. (2023), who reported moderate-to-high fatigue among Filipino learners in technology-mediated educational settings.

Level of Academic Reading Performance

Table 4 presents the distribution of students across Phil-IRI reading levels.

Table 4. Level of Academic Reading Performance of Junior High School Students as Measured by the Phil-IRI

Comprehension Score (%)	Interpretation	Frequency	Percentage (%)	Rank
80–100	Independent	7	4.07	3
59–79	Instructional	95	55.23	1
58 and below	Frustration	70	40.70	2
Total		**172**	**100**	-

Note. Phil-IRI classification: Independent = 80–100%; Instructional = 59–79%; Frustration = 58% and below. Total N = 172.

The majority of respondents (55.23%) were classified at the Instructional Level, indicating that most learners can process grade-level texts when provided with appropriate teacher guidance and instructional scaffolding. Approximately 40.70% were classified at the Frustration Level, representing a significant proportion of learners who struggle to comprehend academic texts at their grade level even with support. Only 4.07% attained the Independent Level, suggesting that autonomous, proficient reading without external support remains an achievement reached by very few Grade 7 students in this context. This pattern mirrors national and international literacy data indicating the Philippines' persistent challenges in reading comprehension. PISA 2018 results placed the country among the lowest-performing nations in reading literacy, with 80.6% of Filipino learners below the minimum proficiency standard (DepEd, 2019). The Phil-IRI performance distribution in the present study is consistent with Abellanoza et al. (2025) and Peras et al. (2023), who found that reading comprehension outcomes are shaped by a complex interaction of cognitive, instructional, and contextual factors, and with the observations of Gepila Jr. et al. (2021) that Filipino learners' engagement with digital platforms has not automatically translated into improved reading proficiency.

Relationship Between Digital Reading Exposure and Digital Reading Fatigue

Table 5 presents the Pearson correlation coefficients and significance levels for the relationships between the four dimensions of digital reading exposure and the five dimensions of digital reading fatigue.

Table 5. Correlations Between Digital Reading Exposure and Digital Reading Fatigue Dimensions

Digital Reading Exposure Dimension	Digital Reading Fatigue Dimension	r	p-value	Conclusion
Digital Use	Cognitive Strain	0.234	0.002	Significant
	Attention Control	0.200	0.009	Significant
	Memory & Comprehension	0.103	0.180	Not Significant
	Emotional Impact	0.249	0.001	Significant
	Physical Signs	0.217	0.004	Significant
Duration of Digital Use	Cognitive Strain	0.171	0.025	Significant
	Attention Control	0.224	0.003	Significant
	Memory & Comprehension	0.079	0.305	Not Significant
	Emotional Impact	0.241	0.001	Significant
	Physical Signs	0.174	0.022	Significant
Type of Content Accessed	Cognitive Strain	0.245	0.001	Significant
	Attention Control	0.213	0.005	Significant
	Memory & Comprehension	0.059	0.442	Not Significant
	Emotional Impact	0.140	0.066	Not Significant
	Physical Signs	0.186	0.014	Significant
Reading Context & Purpose	Cognitive Strain	0.219	0.004	Significant
	Attention Control	0.133	0.083	Not Significant
	Memory & Comprehension	0.005	0.946	Not Significant
	Emotional Impact	0.095	0.215	Not Significant
	Physical Signs	0.113	0.140	Not Significant

Note. *p < .05 (two-tailed). Pearson r significant if p < 0.05.

The null hypothesis (H_{01}) was partially rejected. Significant positive relationships were found between digital reading exposure and cognitive strain, attention control difficulties, emotional impact, and physical signs of fatigue across multiple exposure dimensions. The strongest association observed was between digital use and emotional impact (r = 0.249, p = .001), suggesting that frequent device engagement is most immediately reflected in emotional strain - frustration, stress, and cognitive exhaustion - among learners. Attention control difficulties and physical signs were also significantly associated with digital use (r = 0.200, p = .009; r = 0.217, p = .004, respectively), indicating that attentional dysregulation and somatic fatigue are salient consequences of regular device use.

Memory and comprehension difficulties, however, showed no significant relationship with any dimension of digital reading exposure. This finding suggests that increased digital reading exposure alone may not be sufficient to produce observable difficulties in memory retention and reading comprehension among Grade 7 learners. One possible explanation is that memory and comprehension outcomes are influenced by a broader set of cognitive, instructional, and learner-related factors beyond the frequency or duration of digital reading (Li & Yan, 2024; Peras et al., 2023). It is also possible that the effects of digital exposure on comprehension emerge indirectly through intervening variables such as fatigue, attention regulation, reading strategies, or prior literacy skills (Cardoso-Leite et al., 2021; Loh & Kanai, 2022). Given the cross-sectional nature of the study, caution is warranted when interpreting this non-significant finding. Future research employing longitudinal or experimental designs may provide a clearer understanding of how digital reading conditions relate to memory and comprehension outcomes over time.

Relationship Between Digital Reading Exposure and Academic Reading Performance

Table 6 presents the Pearson correlation results for the relationship between digital reading exposure dimensions and academic reading performance.

Table 6. Correlations Between Digital Reading Exposure Dimensions and Academic Reading Performance

Exposure Dimension	Dependent Variable	r	p-value	Result
Digital Use	Academic Reading Performance	-0.124	0.105	Not Significant
Duration of Digital Use		-0.062	0.418	Not Significant
Type of Content Accessed		-0.135	0.078	Not Significant
Reading Context & Purpose		-0.116	0.129	Not Significant

Note. *Significant if $p < 0.05$. All p-values exceeded the threshold; the null hypothesis was retained for all dimensions.

The null hypothesis (H_{02}) was retained. None of the four dimensions of digital reading exposure demonstrated a statistically significant direct relationship with academic reading performance. While all correlation coefficients were in the negative direction - suggesting a modest inverse trend between digital reading exposure and comprehension - none reached statistical significance. Type of Content Accessed showed the strongest absolute association ($r = -0.135$, $p = 0.078$), followed by Digital Use ($r = -0.124$, $p = 0.105$), though both remained non-significant.

This finding is consistent with Li and Yan (2024), whose meta-analysis found no consistent overall advantage for either digital or print reading in terms of comprehension outcomes, and with Peras et al. (2023), who reported that reading format alone does not adequately explain comprehension differences. Cardoso-Leite et al. (2021) similarly concluded that digital media effects on academic outcomes are best understood through mediating psychological variables - such as attention and fatigue - rather than direct screen-time pathways. The result suggests that digital reading exposure, by itself, is neither academically beneficial nor detrimental: its educational consequences depend on the cognitive conditions it produces, particularly the fatigue it generates in learners with limited cognitive regulation capacity.

Mediation Analysis: Role of Digital Reading Fatigue

Table 7 presents the results of the bootstrapped mediation analysis testing whether digital reading fatigue mediates the relationship between digital reading exposure and academic reading performance.

Table 7. Mediation Analysis of Digital Reading Fatigue on the Relationship Between Digital Reading Exposure and Academic Reading Performance

Path	Relationship Tested	β	t	p	Result
Path a	Digital Reading Exposure → Fatigue	0.342	4.85	0.000	Significant
Path b	Fatigue → Academic Reading Performance	-0.298	-3.97	0.000	Significant

Path c	Total Effect: Exposure → Reading Performance	-0.081	-1.21	0.228	Not Significant
Path c′	Direct Effect: Exposure → Performance (controlling Fatigue)	-0.015	-0.26	0.796	Not Significant
Indirect (a×b)	Exposure → Fatigue → Performance	-0.102	-	-	Significant

Note. Bootstrapping: 5,000 resamples. Indirect effect = -0.102; 95% CI [−0.158, −0.051]. Indirect effect significant as CI excludes zero. Mediation type: indirect-only (full mediation).

The null hypothesis (H_{03}) was rejected. The mediation analysis revealed an indirect-only (full) mediation pattern. Path a - the effect of digital reading exposure on digital reading fatigue - was positive and statistically significant ($\beta = 0.342$, $t = 4.85$, $p < .001$), confirming that higher levels of digital reading exposure significantly predicted greater fatigue. Path b - the effect of digital reading fatigue on academic reading performance - was negative and significant ($\beta = -0.298$, $t = -3.97$, $p < .001$), indicating that higher fatigue was associated with lower reading comprehension scores. The total effect of digital reading exposure on reading performance (Path c) was not significant ($\beta = -0.081$, $p = .228$), and the direct effect after controlling for fatigue (Path c′) was likewise non-significant ($\beta = -0.015$, $p = .796$), confirming that the entire effect of digital exposure on reading performance operates through the fatigue pathway. The indirect effect ($a \times b = -0.102$) was statistically significant, with a 95% bootstrap confidence interval of [−0.158, −0.051] that excluded zero.

This indirect-only mediation pattern carries theoretical and practical significance. It empirically confirms that digital reading exposure affects academic reading performance not through direct cognitive disruption but through the fatigue-related pathway: prolonged engagement with digital devices increases cognitive, attentional, and physical strain, which subsequently impairs comprehension. This interpretation is supported by Zhuang et al. (2023), who found that fatigue serially mediated the relationship between social media addiction and academic engagement among college students, and by Ramos-Vera et al. (2024), who documented the role of cognitive exhaustion as an intermediary variable between academic demands and performance outcomes. The finding is consistent with Cognitive Load Theory's prediction that extraneous load accumulation - in this case, generated by digital reading - eventually degrades learning performance through resource depletion (Sweller, 1988). Lyu and Hu (2025) similarly demonstrated that intermediary cognitive processes function as critical pathways through which learning conditions translate into academic outcomes. The implication is that reducing digital reading fatigue, rather than simply reducing digital reading exposure, is the more proximal lever for improving academic reading performance in digital learning environments.

While the mediation model provides a useful explanation for the relationship between digital reading exposure and academic reading performance, it should not be interpreted as a complete account of reading achievement. Reading performance is a multidimensional outcome influenced by numerous factors, including prior literacy proficiency, vocabulary knowledge, reading motivation, socioeconomic conditions, parental support, teacher scaffolding, access to print resources, and broader learning environments (DepEd, 2019; Peras et al., 2023; Mercado & Manzano, 2024). Previous research has consistently demonstrated that reading achievement emerges from the interaction of cognitive, instructional, and contextual influences rather than from a single predictor alone (Abellanoza et al., 2025; Mirasol, 2024). The present findings, therefore, highlight one important pathway through which digital reading conditions may relate to reading outcomes, while recognizing that other academic, social, and environmental factors may also contribute substantially to students' reading performance.

CONCLUSION

This study provides empirical evidence that digital reading fatigue significantly explains the relationship between digital reading exposure and academic reading performance among Grade 7 students. While learners demonstrated high engagement with digital reading activities, digital reading exposure alone was not directly associated with reading performance. Instead, the findings suggest that the effects of digital reading exposure operate through fatigue-related cognitive, attentional, emotional, and physical processes. Digital reading fatigue statistically mediated the relationship between digital reading exposure and academic reading performance, supporting the view that the educational consequences of digital reading are influenced not merely by exposure itself but by the conditions and experiences that accompany digital engagement.

The findings have important implications for educational practice and policy. Efforts to improve reading outcomes in technology-rich learning environments should focus on reducing fatigue-related barriers to learning through structured screen breaks, balanced use of digital and print reading materials, and the development of students' self-regulation and attention-management skills. Schools and educational leaders may also consider integrating digital wellness initiatives into literacy programs to promote healthier and more effective reading habits. The study further contributes to the growing literature on digital learning by providing evidence that fatigue serves as an important mechanism linking digital reading experiences to academic outcomes.

Despite its contributions, several limitations should be acknowledged. The study was conducted in a single public secondary school and focused exclusively on Grade 7 students, which may limit the transferability of the findings to other educational contexts. Measures of digital reading exposure and digital reading fatigue were based on self-reported responses and may therefore be influenced by response biases. Moreover, the cross-sectional and non-experimental nature of the study permits the examination of statistical mediation but does not support strong causal conclusions. Other factors that may influence reading performance, including prior literacy proficiency, socioeconomic conditions, parental support, reading motivation, vocabulary knowledge, teacher scaffolding, and access to print materials, were not included in the model. Future research may address these limitations through longitudinal, experimental, and multi-site studies that incorporate a broader range of learner and contextual variables.

Ethical Approval

This study was conducted in accordance with established ethical standards for educational research involving human participants. Prior to data collection, approval and permission to conduct the study were obtained from the Schools Division Office and the administration of Bislig City National High School. Written informed consent was secured from the parents or legal guardians of the student participants, while informed assent was obtained from the students themselves. Participation was voluntary, and respondents were informed of their right to withdraw at any stage of the study without penalty. Confidentiality and anonymity were maintained throughout the research process, and all collected data were used solely for academic and research purposes.

Conflict of Interest

The authors declare no conflict of interest regarding the publication of this study.

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Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request. Access to the data may be subject to institutional policies and ethical restrictions concerning research involving minor participants.

Author Contributions

Melanie D. Cayanong conceptualized the study, developed the research instruments, collected and analyzed the data, interpreted the findings, and prepared the original manuscript draft. Rolly G. Salvaleon provided research supervision, contributed to the study design and methodology, reviewed and refined the analysis and interpretation of results, and critically revised the manuscript for important intellectual content. Both authors reviewed and approved the final version of the manuscript.

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