The Effect of Duration of Digital Content Consumption and Type of Digital Platform on Adolescent Sleep Patterns through Sleep Quality at SMA Negeri 4 Bogor

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Abstract. The widespread use of digital platforms has significantly changed adolescents' daily habits, including their sleep patterns. This study investigates the impact of digital content consumption duration and platform types on the sleep patterns of high school students, mediated by sleep quality. Conducted at SMA Negeri 4 Bogor, the research uses a quantitative explanatory approach with a sample of 100 students selected via stratified random sampling. Data were collected using online questionnaires and analyzed through Partial Least Squares (PLS) with SmartPLS. Results reveal that both duration and type of digital platform significantly influence sleep quality and patterns. Social media and online gaming, in particular, contribute to late bedtimes and lower sleep quality. Sleep quality was found to mediate the effect of digital behavior on sleep patterns. The findings suggest that reducing screen time before bedtime and choosing less stimulating platforms can improve sleep hygiene. This study offers practical insights for educators and parents to promote healthier digital habits and better adolescent sleep quality.

Keywords: digital content, sleep pattern, sleep quality, adolescents, digital platforms.

Introduction

The digital revolution has fundamentally reshaped human lifestyles, particularly among adolescents who are now considered digital natives. Easy access to the internet, coupled with widespread personal ownership of mobile devices, has made digital content consumption an integral part of adolescents' daily routines. The content they engage with varies widely, from social media, entertainment videos, and online games to educational applications. While these platforms offer numerous benefits, they also pose potential risks to psychological and physiological health, particularly in relation to sleep quality and patterns.

Adequate and high-quality sleep is a biological necessity for adolescents to support their physical growth, emotional regulation, and cognitive function. Research shows that adolescents require 8–10 hours of sleep per night to function optimally in both academic and social settings. However, current trends reveal a significant number of teenagers experiencing sleep disturbances due to unregulated digital behavior. Blue light exposure, emotional involvement in interactive content, and binge-watching or gaming before bedtime are major contributors to delayed sleep onset and poor sleep quality.

Prior studies (Cain & Gradisar, 2010; Kuss & Griffiths, 2017; Chang et al., 2015) have established correlations between digital media use and sleep problems. Nevertheless, most of these studies are conducted in Western contexts and often do not focus specifically on the role of platform types or the mediating impact of sleep quality. Moreover, there is limited research addressing this issue among Indonesian adolescents, whose cultural, educational, and behavioral contexts may differ significantly

from those in existing literature.

In light of the Sustainable Development Goals (SDGs), particularly Goal 3: "Good Health and Well-being", adolescent sleep health can be regarded as a public health concern. Sleep-deprived teenagers are more likely to experience heightened stress levels, lower academic achievement, and increased risk of mental health issues such as anxiety and depression. A deeper understanding of the factors influencing adolescent sleep is thus essential for developing effective educational and health interventions.

This study focuses on students at SMA Negeri 4 Bogor, a public high school in an urban Indonesian setting, to explore the interplay between digital behavior and sleep. Preliminary observations and informal interviews with school counselors indicate that most students spend over 5 hours a day using digital devices, with more than 60% doing so after 9 PM. Such habits raise concerns about potential impacts on their sleep health.

Given this background, the objectives of this study are to:

1. Examine the impact of digital content consumption duration on adolescent sleep patterns.
2. Investigate the effect of different digital platform types on sleep behavior.
3. Assess the mediating role of sleep quality in the relationship between digital habits and sleep patterns.
4. Provide data-driven recommendations for schools and parents to promote healthier digital habits.

Literatur Review

This study examines the relationship between digital content consumption, types of digital platforms, sleep quality, and adolescents' sleep patterns. The first variable,digital content consumption duration, refers to the amount of time adolescents spend accessing digital content, including social media, video streaming, and online games. Nirmala (2021) explained that prolonged screen time, especially at night, disrupts the body's biological sleep rhythm. Fitriana (2021) added that extended screen exposure physiologically suppresses melatonin production, a hormone responsible for regulating sleep onset. Rahardjo (2022) also found that digital content usage exceeding four hours per day significantly contributed to delayed bedtime and inconsistent wake times, making digital usage a critical factor in adolescent sleep health.

The second variable,types of digital platforms, refers to the specific digital media or applications adolescents use, such as TikTok, YouTube, Instagram, online games, or educational platforms. Each platform provides different psychological and cognitive stimulation. Melati (2021) found that fast-paced, autoplay platforms like TikTok and YouTube Shorts exacerbate sleep disturbances by overstimulating brain activity, making it harder to relax. Prasetyo (2022) noted that competitive online games stimulate adrenaline and emotional intensity, preventing users from entering deep sleep stages. Conversely, Kania (2020) argued that platform type does not significantly affect sleep quality if usage is well managed. Thus, the effect of platform type is strongly associated with user behavior and sleep hygiene.

Sleep quality, the mediating variable in this study, is defined as the comfort, effectiveness, and satisfaction experienced during sleep. Nugroho (2020) reported that poor sleep quality often includes difficulty falling asleep, frequent awakenings, and fatigue upon waking. Ramdhan (2023) emphasized that good sleep quality helps regulate circadian rhythms and supports a consistent sleep schedule. Therefore, sleep quality serves as a key variable bridging the influence of digital behavior on sleep outcomes.

The dependent variable,adolescent sleep patterns, refers to the regularity of bedtimes and wake times, sleep duration, and consistency in daily sleep routines. Yuliana (2022) stated that adolescents often experience disrupted sleep patterns due to academic pressure and nighttime digital use. Susanti (2021) found that irregular sleep patterns are strongly associated with fatigue, reduced focus, and increased academic stress. Sleep patterns are not only a direct outcome of content consumption and platform types, but also indirectly shaped by the mediating effect of sleep quality.
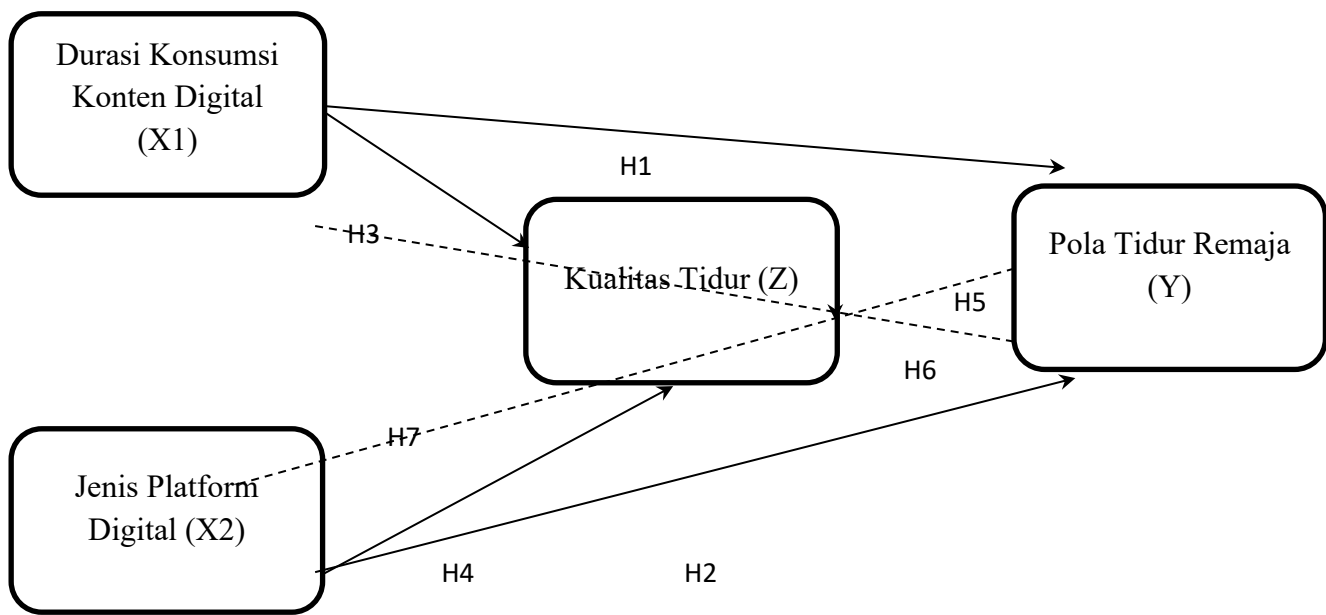
Methods

This research employed a quantitative explanatory approach with the aim of exploring and testing the direct and indirect effects of digital content consumption on adolescent sleep patterns, with sleep quality acting as a mediating variable. The explanatory design enables the identification of causal relationships between variables by combining theoretical reasoning with empirical testing. It goes beyond mere description and is particularly appropriate for models that involve latent variables and require hypothesis testing based on structural relationships.

The study was conducted at SMA Negeri 4 Bogor, a public senior high school located in the urban area of Bogor, Indonesia. The school was chosen based on accessibility, student device ownership, and prior reports from school counselors regarding students' intensive digital activity, especially at night. The total population consisted of approximately 900 students from grades X to XII. From this population, a sample of 100 students was selected using a stratified random sampling technique. This method ensured proportional representation across grade levels and minimized sampling bias, thus enhancing the generalizability of the findings.

The determination of sample size followed the recommendations of Hair et al. (2014) for Partial Least Squares Structural Equation Modeling (PLS-SEM), which advises a sample size of 5 to 10 times the number of indicators in the measurement model. With 20 indicators in this study, the chosen sample size of 100 respondents met the minimum threshold required for reliable and stable model estimation.

The instrument used for data collection was a self-developed online questionnaire constructed based on relevant theories and adapted from validated instruments such as the Pittsburgh Sleep Quality Index (PSQI), the Internet Addiction Test (IAT), and digital media usage scales from prior studies. The questionnaire was divided into four major constructs and employed a five-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Each section measured a distinct latent variable with multiple indicators.

The first independent variable, Digital Content Consumption Duration (X1), was measured using five indicators that assessed daily average screen time, nighttime usage patterns, frequency of device usage before bed, extent of digital multitasking, and difficulty disengaging from devices at night. These indicators were selected to capture both the quantitative intensity and behavioral tendencies associated with prolonged digital exposure.

The second independent variable, Type of Digital Platform (X2), assessed the frequency and preference

of different platform categories, namely social media, video streaming, online gaming, and educational applications. Respondents were also asked to report which platform they primarily used during evening hours, as prior literature suggests differential cognitive and emotional impacts of each platform type on arousal and sleep latency.

The mediating variable, Sleep Quality (Z), was operationalized using five key dimensions adapted from the PSQI: self-reported sleep duration, sleep latency, sleep disturbances (e.g., nighttime awakenings), sleep efficiency (restfulness upon waking), and overall satisfaction with sleep. These components provided a holistic measure of sleep health and served as a bridge between digital behavior and sleep outcomes.

The dependent variable, Sleep Pattern (Y), was measured through items reflecting bedtime regularity, wake time consistency, frequency of delayed sleep onset, morning drowsiness, and perceived impact on school performance or concentration. The focus was not merely on the time of sleep, but on pattern consistency and its functional consequences, aligning with the clinical and educational relevance of the variable.

Prior to full deployment, the instrument was subjected to content validation by two academic experts in psychology and adolescent education. A pilot study involving 30 students (excluded from the main sample) was conducted to evaluate item clarity, internal consistency, and preliminary reliability. The resulting Cronbach's Alpha values for each construct exceeded 0.80, indicating satisfactory reliability.

Data collection was conducted online via Google Forms during a two-week period in April 2025. Participation was voluntary, and all respondents provided informed consent, with school permission granted for ethical clearance. To ensure data quality, all entries were screened for completeness, response time, and consistency, with incomplete or patterned responses excluded from final analysis.

Data analysis was performed using Partial Least Squares - Structural Equation Modeling (PLS-SEM) with SmartPLS 4 software. PLS-SEM was chosen for its ability to handle complex models involving multiple reflective latent constructs and its robustness with smaller sample sizes and non-normal data distributions. It also allows for the estimation of both direct and indirect effects, which is essential in studies involving mediating variables.

The analytical process began with the evaluation of the measurement model (outer model), which involved assessing convergent validity (using outer loading values > 0.70 and Average Variance Extracted > 0.50), discriminant validity (using the Fornell-Larcker criterion and cross-loadings), and construct reliability (Composite Reliability and Cronbach's Alpha > 0.70). Items failing to meet the thresholds were considered for removal or revision.

Subsequently, the structural model (inner model) was assessed to examine the significance of hypothesized relationships. The model's path coefficients, t-statistics, and p-values were generated through a bootstrapping procedure involving 5,000 resamples. In addition to hypothesis testing, the model's explained variance (R^2), predictive relevance (Q^2), and effect size (f^2) were also analyzed to evaluate the overall quality of the model. The presence and strength of mediation were tested using indirect effects in the bootstrapped model.

Finally, the results of the structural model were interpreted in conjunction with theoretical expectations and prior empirical findings. The implications of each significant path were discussed not only in statistical terms, but also in relation to practical actions that could be implemented by schools, parents, and stakeholders concerned with adolescent well-being in the digital age.

Result and Discussion

This study uses Partial Least Squares Structural Equation Modeling (PLS-SEM) to examine the direct and indirect relationships among digital content consumption duration, digital platform type, sleep quality, and adolescent sleep patterns. The structural model testing aims to assess the significance and strength of the proposed hypotheses, which are evaluated through Path Coefficients (for direct effects) and Specific Indirect Effects (for mediation analysis)

The analysis is carried out in two main stages. First, the Path Coefficients are analyzed to determine whether digital content duration and platform type significantly affect sleep quality and sleep patterns directly. Second, the Specific Indirect Effects are examined to test whether sleep quality functions as a mediating variable between digital media behavior and adolescent sleep outcomes.

The results of each stage are presented in the following tables. These include statistical values such as the original sample (O), t-statistic, and p-value, which serve as the basis for determining the significance of each relationship in the model.

Table 1 : path coefficients

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
x1. -> y	0.333	0.364	0.131	2.533	0.011
x1. -> z	0.412	0.413	0.103	4.000	0.000
x2. -> y	-0.000	0.004	0.107	0.001	0.999
x2. -> z	0.469	0.472	0.095	4.918	0.000
z -> y	0.515	0.485	0.148	3.489	0.000

The path coefficient from digital content duration to sleep pattern is positive and statistically significant ($\beta = 0.333$; $p = 0.011$), suggesting that increased screen time is associated with changes in adolescent sleep behavior. This supports the idea that longer digital media exposure can negatively influence when and how adolescents sleep.The path from digital content duration to sleep quality is also significant ($\beta = 0.412$; $p = 0.000$), indicating that prolonged usage is linked to lower sleep quality. This might include difficulty falling asleep, sleep interruptions, or waking up feeling unrested.

Although the path from digital platform type to sleep pattern is not statistically significant ($\beta = -0.000$; $p = 0.999$), the significant path from platform type to sleep quality ($\beta = 0.469$; $p = 0.000$) shows that the type of platform (e.g., social media, streaming, gaming) can still impact adolescents' perceived sleep quality, even if not directly affecting their sleep timing or duration.The strongest direct effect is found between sleep quality and sleep pattern ($\beta = 0.515$; $p = 0.000$), reinforcing the crucial role of sleep quality as a determinant of consistent and healthy sleep patterns among adolescents.These findings highlight the importance of sleep quality as a central link in the relationship between digital behavior and adolescent sleep patterns. Further insights on this mediated influence are explored in the next section under Specific Indirect Effects.

Tabel 2 : Spesific Indirect Efect

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
x1. -> z -> y	0.212	0.195	0.067	3.154	0.002
x2. -> z -> y	0.241	0.232	0.095	2.537	0.011

The indirect effect of digital content duration (X1) on sleep pattern (Y) through sleep quality (Z) is statistically significant, with a coefficient of 0.212, t-statistic of 3.154, and p-value of 0.002. This indicates that sleep quality plays a mediating role in the relationship between screen time and adolescent sleep patterns.Even if the direct effect of digital content duration on sleep pattern is significant, this indirect path suggests that part of the influence occurs through its impact on sleep quality. In other words, excessive screen time degrades sleep quality, which in turn leads to more irregular or unhealthy sleep patterns.Similarly, the indirect effect from platform type (X2) to sleep pattern (Y) via sleep quality (Z)

is also significant (β = 0.241; p = 0.011). While the direct effect of platform type on sleep pattern was not significant, this result confirms that platform type still influences sleep patterns, but indirectly by first affecting sleep quality. Certain platforms may be more stimulating, increase cognitive arousal, or prolong exposure to blue light, all of which reduce sleep quality, and thereby affect sleep timing and structure.These findings emphasize the important mediating role of sleep quality, reinforcing that the relationship between adolescents' digital behavior and their sleep patterns is not always direct, but may occur through deterioration in sleep quality. Therefore, any intervention aiming to improve adolescent sleep behavior should also address sleep hygiene and the psychological effects of digital consumption.

Conclusion

This study provides strong empirical evidence of the complex relationship between digital behavior and adolescent sleep patterns. Specifically, it was found that both the duration of digital content consumption and the type of platform used have significant direct and indirect effects on students' sleep patterns, with sleep quality serving as a key mediating variable. The analysis using PLS-SEM demonstrated that longer digital usage, especially in the evening hours, is associated with later bedtimes, reduced sleep duration, and higher levels of daytime fatigue. Furthermore, digital platforms that are emotionally engaging and highly interactive such as social media and online gaming had stronger negative impacts on sleep compared to more passive or educational digital platforms. The students who used these interactive platforms before bedtime were more likely to experience delayed sleep onset, interrupted rest, and decreased alertness the following day.

Importantly, the findings revealed that sleep quality does not merely act as a consequence but also serves as a crucial bridge in the pathway between digital consumption and sleep patterns. In both measured paths from digital usage duration and from platform type sleep quality was found to significantly mediate the effect on sleep outcomes. This indicates that even when adolescents do not sleep particularly late, their rest may still be compromised in quality due to the overstimulation, light exposure, and psychological engagement caused by digital activity. These insights deepen our understanding of the nuanced ways in which technology interacts with human biology and adolescent development. Not all screen time has the same effect; the nature of the content, its intensity, and its interactivity all play critical roles.

From a theoretical perspective, this research builds upon and refines existing models of adolescent digital behavior. It supports earlier frameworks such as the Uses and Gratifications Theory, which explains how individuals seek out media to fulfill psychological needs, and highlights that the gratification received from late-night screen use may be undermining essential biological processes. It also reinforces the importance of including mediating variables such as sleep quality when modeling digital behavior, instead of oversimplifying the relationship into binary cause-effect logic. This contribution offers both methodological and conceptual improvements to the field of adolescent sleep research in the digital age.

Practically speaking, the findings of this study carry significant implications for schools, parents, policymakers, and adolescents themselves. For schools, the integration of digital literacy and sleep education into the curriculum is recommended, particularly through school counseling programs and classroom routines that emphasize healthy digital use. Teachers and counselors should promote screen hygiene and model balanced media habits. For parents, the findings emphasize the importance of co-regulating digital habits with their children. Rather than enforcing restrictions, families should aim to build shared agreements about screen-free periods, especially before bedtime. For adolescents, awareness-building efforts should focus on helping them understand how seemingly harmless behaviors like scrolling social media or gaming late at night can gradually erode their cognitive performance, mood, and physical well-being.

At the policy level, education and health authorities are encouraged to collaborate in crafting campaigns and materials that promote digital health as a component of overall adolescent wellness. Public health programs should emphasize the science of sleep, the impact of digital overstimulation, and the importance of nighttime routines. In addition, platform designers and digital developers should be encouraged if not regulated to implement features that minimize late-night use, such as night modes, usage reminders, or soft screen locks during designated sleep hours.

Despite the strength of the findings, this study has limitations. The sample was drawn from a single urban high school, and therefore may not represent broader adolescent populations in rural or lower-income settings. Additionally, all data were self-reported, which introduces potential bias in the form of social desirability or inaccurate recall. The study design was cross-sectional, meaning that while relationships were statistically significant, causality cannot be definitively established. Other potential influencing factors such as stress, diet, physical activity, and academic pressure were not controlled for, though they may moderate or interact with the observed relationships.

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