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Academic engagement in the digital era: An analysis of the influence of social networking sites through study discipline and sleep quality

Firman Sathia Ajie^{1*}, Sunawan², Anwar Sutoyo³

^{1,2,3}Universitas Negeri Semarang, Indonesia

Article Info	Abstract
Keywords: Social networking sites, academic engagement, study discipline, sleep quality, high school students.	The widespread use of Social Networking Sites (SNS) among adolescents has raised concerns about students' learning processes. This study aims to analyze the impact of SNS use on high school students' academic engagement, both directly and through the mediating roles of study discipline and sleep quality. This correlational quantitative research involved 375 eleventh-grade students from four public high schools in Semarang City, selected using simple random sampling. Data were collected using standardized questionnaires that had been tested for validity and reliability. The collected data were then analyzed using Hayes' PROCESS Model 6 in SPSS with 5,000 bootstrap samples. The results revealed that SNS use had a significant positive effect on academic engagement (direct effect $\beta = 0.447$, $p < .001$), and there was also a significant indirect effect through study discipline and sleep quality simultaneously (serial indirect effect $\beta = 0.304$). These findings indicate that the impact of SNS on academic engagement is not entirely negative but is influenced by students' ability to manage study time and maintain healthy sleep patterns. This study enriches the literature on academic engagement in the digital era and provides practical implications for schools in developing programs on digital literacy, study discipline, and students' sleep health, as well as serving as a reference for future research.

*Correspondence address:

E-mail: ajifirman000@students.unnes.ac.id

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Introduction

Academic engagement is a key factor in educational success as it reflects students' cognitive, affective, and behavioral involvement in the learning process (Fredricks et al., 2004; Skinner & Pitzer, 2012). In general, academic engagement is understood as the level of energy, effort, and commitment students demonstrate in learning activities, both inside and outside the classroom (Skinner & Pitzer, 2012). According to Fredricks et al. (2004), academic engagement consists of three main indicators: cognitive engagement (learning strategies, problem-solving, and intellectual effort), affective engagement (interest, positive emotions, and attitudes toward learning), and behavioral engagement (active participation, attendance, discipline, and completing assignments on time). Thus, academic engagement encompasses not only learning outcomes but also the process by which students make meaning, feel, and behave in academic activities. High levels of academic engagement have been shown to enhance students' motivation, achievement, and psychological well-being (Fredricks et al., 2004; Schunk & DiBenedetto, 2020; Gheibi, 2021).

However, global reports over the past decade indicate a declining trend in academic engagement among adolescents (Organisation for Economic Co-operation and Development \[OECD\], 2023; United Nations Educational, Scientific and Cultural Organization \[UNESCO\], 2024), including in Indonesia. This condition highlights a serious challenge in the digital era regarding students' readiness to maintain motivation, study discipline, and daily life quality. Factors such as low self-regulation and increasing distractions caused by digital technology further widen the research gap, particularly in explaining how mediating variables such as study discipline and sleep quality can influence the relationship between SNS use and academic engagement.

Previous studies have shown that the use of Social Networking Sites (SNS) has a dual impact. SNS are internet-based digital platforms that allow individuals to create personal profiles, build friendships, exchange messages, share content, and participate in virtual communities (Boyd & Ellison, 2007). Indicators of SNS use include access frequency, duration of use, interaction intensity, and purposes of use (Ellison et al., 2011). On one hand, SNS can enhance access to learning resources, expand information networks, and support collaborative interactions (Gómez-García et al., 2020; Johnson et al., 2022). Recent studies also highlight the role of SNS in improving academic engagement when used productively (Li et al., 2023; Alasmari, 2023). Social connectedness and information exchange through SNS have the potential to strengthen students' academic engagement, particularly in cognitive and affective aspects.

Excessive use of SNS is often associated with decreased study discipline, lower concentration, and poor sleep quality (Kirschner & De Bruyckere, 2017; Wang et al., 2022). Poor sleep quality has been proven to negatively affect motivation, focus, and academic performance (Becker et al., 2018; Dewald-Kaufmann et al., 2019). Recent studies also emphasize that sleep disturbances caused by nighttime exposure to digital media are directly linked to reduced academic engagement (Levenson et al., 2023). Within this framework, study discipline functions as a self-regulation mechanism that governs students' consistency and focus in utilizing SNS for learning purposes.

When study discipline declines, academic engagement also tends to weaken (Schunk & DiBenedetto, 2020; Kirschner & De Bruyckere, 2017). Similarly, sleep quality is a crucial physiological factor that determines students' cognitive and emotional readiness; the poorer the sleep quality, the lower the energy and attention that can be devoted to academic activities (Becker et al., 2018; Dewald-Kaufmann et al., 2019; Levenson et al., 2023). Therefore, study discipline and sleep quality function as mediators that explain the mechanism by which SNS affects academic engagement. Literature over the past decade underscores that digital behavior, self-regulation, and physiological conditions are interrelated factors crucial to academic engagement.

Although several studies have examined the relationship between SNS and academic aspects, most have only emphasized the direct effects without considering the mediating mechanisms that explain the relationship more comprehensively. Research that integrates digital behavior (SNS), self-regulation (study discipline), and physiological factors (sleep quality) into a single conceptual model remains very limited, particularly in the context of Indonesian adolescents. Therefore, this study offers novelty by testing study discipline and sleep quality as simultaneous mediators in the relationship between SNS use and academic engagement.

Based on the background and research gap, this study aims to analyze the effect of SNS use on the academic engagement of high school students in Semarang City, both directly and indirectly through study discipline and sleep quality. This research is expected to provide theoretical contributions by enriching the study of academic engagement in the digital era, while also offering practical recommendations for schools and counseling teachers in designing interventions to enhance students' academic engagement.

Method

This study employs a quantitative approach with a correlational design to analyze the effect of SNS use on students' academic engagement, both directly and indirectly through study discipline and sleep quality.

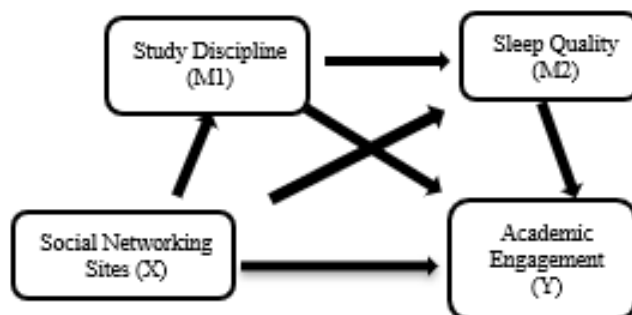


Figure 1. Conceptual Framework Diagram

The research population comprised all students from four public senior high schools in Semarang City. A sample of 375 students was determined using a simple random sampling technique based on Slovin's formula with a 5% margin of error. The research instrument consisted of standardized questionnaires that had undergone pilot testing, validity, and reliability assessments. The instruments included: (1) an SNS usage scale with 20 items; (2) a study discipline scale with 20 items; (3) a sleep quality scale with 18 items adapted from the

Pittsburgh Sleep Quality Index (PSQI); and (4) an academic engagement scale with 24 items covering cognitive, affective, and behavioral dimensions. All instruments used a 4-point Likert scale (from strongly disagree to strongly agree). Validity testing showed that all items had correlation coefficients > 0.30 , while reliability testing indicated Cronbach's Alpha values > 0.70 across all instruments.

The data collection procedure was carried out after obtaining official permission from the schools. Questionnaires were distributed directly in classrooms, completed by respondents, and collected immediately afterward. Data collection was conducted once, following confirmation that the instruments were valid and reliable. Data were analyzed using mediation analysis with Hayes' PROCESS Model 6 through SPSS. The analysis was conducted in stages, including descriptive tests, assumption testing, validity and reliability tests, and path analysis covering direct, indirect, and total effects. The significance of mediation effects was tested using the bootstrapping technique with 5,000 samples, applying a significance threshold of $p < 0.05$ and 95% confidence intervals that did not include zero.

Result and Discussion

The results of the study indicate a significant effect of SNS use on high school students' academic engagement. Path analysis using Hayes' PROCESS Model 6 with 5,000 bootstrap samples revealed that SNS use had a direct effect on students' academic engagement ($\beta = 0.447, p < 0.001$). In addition, indirect effects were found through study discipline ($\beta = 0.172, p < 0.01$), sleep quality ($\beta = 0.094, p < 0.05$), and the serial pathway of study discipline–sleep quality ($\beta = 0.304, p < 0.01$). These results demonstrate that although the direct effect of SNS is more dominant, the indirect mechanisms through study discipline and sleep quality also play a significant role, underscoring the importance of self-regulation and physiological conditions in strengthening students' academic engagement.

Table 1. Summary of path analysis of SNS use on academic engagement

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Predictor path → Criterion	β	p	
SNS → Academic engagement	0.447	<.001	
SNS → Study discipline	-0.282	<.001	
SNS → Sleep quality	-0.247	<.001	
Study discipline → Sleep quality	0.140	<.001	
Study discipline → Academic engagement	0.119	<.001	
Sleep quality → Academic engagement	0.273	<.001	
Path	β	SE	p
SNS → Academic engagement	0.447	0.052	<.001
SNS → Study discipline → Academic engagement	0.172	0.031	<.01
SNS → Sleep quality → Academic engagement	0.094	0.028	<.05
SNS → Study discipline → Sleep quality → Academic engagement	0.304	0.041	<.01

The trend of the findings also shows that students with strong study discipline and good sleep quality tend to maintain their academic engagement despite intensive use of SNS. Table 1 summarizes the path analysis results, presenting both the direct and indirect effects of the research variables.

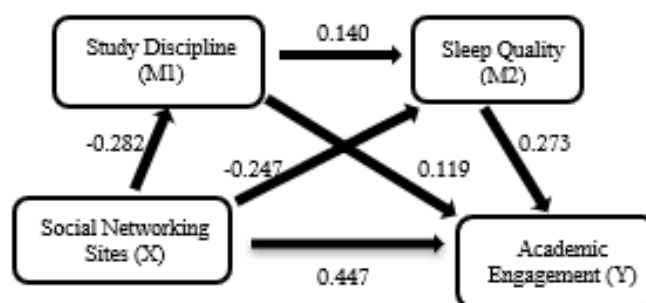


Figure 2. Diagram of the Causal Relationships among Variables

The findings of this study indicate that SNS use can enhance students' academic engagement when utilized productively, such as for discussions, collaboration, or accessing learning materials. This result supports the research of Gómez-García et al. (2020), which emphasizes that the use of digital tools for educational

purposes contributes to improved learning outcomes. Similarly, Johnson et al. (2022) highlight that social media platforms can serve as peer learning tools that strengthen academic motivation. Thus, the positive direct relationship between SNS and academic engagement ($\beta = 0.447$) confirms that social media holds potential as an educational resource when purposefully integrated.

Nevertheless, SNS use also carries potential risks for students' self-regulation. The findings of this study indicate negative consequences for study discipline ($\beta = -0.282$). The negative effect of SNS on study discipline is consistent with Kirschner and De Bruyckere (2017), who found that digital multitasking weakens concentration and reduces the depth of cognitive processing. Similarly, Wang et al. (2022) showed that students who spend excessive time on social media are more likely to experience academic procrastination, which disrupts learning achievement. Moreover, Mou et al. (2024) emphasized that social media addiction can reduce academic engagement through a serial mediation mechanism. In other words, SNS can be a double-edged sword that either supports or hinders academic engagement, depending on students' self-regulation.

In addition, this study found that SNS negatively affects students' sleep quality ($\beta = -0.247$). This relationship is consistent with Becker et al. (2018), who reported that blue light exposure and emotional involvement in social media before bedtime reduce adolescents' sleep quality. Dewald-Kaufmann et al. (2019) emphasized that insufficient sleep is associated with decreased concentration, working memory, and academic performance. A systematic review by Dibben (2023) further supports evidence that the use of interactive electronic devices correlates with sleep disturbances and mental health issues among adolescents, while de Sá et al. (2023) specifically highlighted the role of smartphones in disrupting adolescents' sleep duration and quality. These sleep disturbances have implications not only for academic performance but also for adolescents' mental health (Alimoradi et al., 2022).

The dual mediation of study discipline and sleep quality in this study demonstrates that the effect of SNS on academic engagement is not linear. Study discipline has a positive effect on academic engagement ($\beta = 0.119$), while sleep quality also positively influences academic engagement ($\beta = 0.273$). Moreover, there is a positive relationship between study discipline and sleep quality ($\beta = 0.140$), which reinforces the serial mediation mechanism. These findings are consistent with Zimmerman's (2000) self-regulation model, which posits that academic engagement results from the interaction of behavioral, cognitive, and environmental factors. Li et al. (2023) also support this mechanism by showing that healthy sleep patterns and time management serve as significant mediators in the relationship between internet use and adolescents' academic achievement. Furthermore, Vik et al. (2022) emphasize that sleep deficits are consistently correlated with lower academic achievement, reinforcing the role of sleep quality as a critical factor in students' academic engagement.

The findings of this study show that the direct effect of SNS use on students' academic engagement is greater than the indirect effects through study discipline and sleep quality. The direct effect of SNS on academic engagement was recorded with a coefficient of $\beta = 0.447$ ($p < .001$), while the indirect effect through study discipline was only $\beta = 0.080$ and through sleep quality $\beta = 0.061$. Thus, the direct effect of SNS is nearly six times greater than the mediation pathway through study discipline and about seven times greater than the mediation pathway through sleep quality. This indicates that students' academic engagement is more dominantly influenced by SNS use directly rather than indirectly through self-regulation or physiological conditions. These findings are consistent with Gómez-García et al. (2020), who emphasized the positive role of digital media in supporting learning outcomes, while also underscoring the importance of integrating SNS use into academic activities productively.

The results of this study also highlight inconsistencies with several studies that argue SNS does not have a significant impact on sleep quality when used in moderation (Scott & Woods, 2019). This discrepancy is likely due to cultural context and usage intensity in Indonesia, where SNS use tends to be higher and less regulated. This underscores the importance of considering contextual factors when interpreting the relationship between SNS and academic as well as psychological aspects.

Overall, this research expands the theoretical understanding of academic engagement by integrating three key aspects SNS use, study discipline, and sleep quality into a single simultaneous mediation model. The findings contribute significantly to self-regulation theory and educational practice by emphasizing how the interaction between digital technology, self-regulation, and physiological conditions can influence academic engagement. From a practical perspective, the findings affirm the need for schools and guidance counselors to develop programs in digital literacy, time management training, and sleep health education. Such interventions will help students maximize the potential of SNS as an academic tool without sacrificing their self-regulation or physiological well-being.

Conclusion

This study concludes that the use of SNS has a significant positive effect on students' academic engagement, both directly and through the mediation of study discipline and sleep quality. The findings indicate that the impact of SNS is not entirely negative but is determined by students' ability to manage their study time and maintain healthy sleep patterns. Therefore, leveraging SNS as a learning tool should be accompanied by digital literacy, study discipline management, and sleep health education to optimize academic benefits without compromising students' well-being.

Author Contributions Statement

Firman Sathia Ajie: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Writing – original draft. **Sunawan:** Supervision, Methodology, Validation, Writing – review & editing. **Anwar Sutoyo:** Supervision, Project administration, Validation, Writing – review & editing. All authors have reviewed and approved the final version of the manuscript for publication.

Declaration of Generative AI

During the preparation of this manuscript, the authors used ChatGPT to support language refinement and enhance the clarity and readability of the text. The authors subsequently reviewed and revised the generated suggestions as appropriate and accept full responsibility for the accuracy, integrity, and final content of the published article.

Declaration of Competing Interest

The authors report no known financial conflicts of interest or personal relationships that could reasonably be perceived as influencing the research presented in this article.

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