Does Self-Regulated Learning Mediate the Effect of Smartphone Addiction on Academic Procrastination? A SEM Analysis

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Abstract

Delays in completing final assignments are common among final-year students. This research aims to examine the influence of smartphone addiction on academic procrastination through the mediator of self-regulated learning. The study uses a quantitative approach, with data collection methods involving academic procrastination scales, smartphone addiction, and self-regulated learning. The respondents in this study consisted of 304 students, selected using purposive sampling. The data were analyzed using Structural Equation Modeling (SEM) with Amos version 26. The research findings indicate that (1) there is a positive effect of smartphone addiction on academic procrastination, (2) there is a negative effect of smartphone addiction on self-regulated learning, (3) there is a negative effect of self-regulated learning on academic procrastination through the mediator of self-regulated learning, and (4) smartphone addiction influences academic procrastination through the mediator of self-regulated learning.

Keywords: Academic procrastination, final assignment, smartphone, self-regulated learning, final-year students.

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Introduction

Procrastination is inseparable from students' academic journeys (Sholikhah et al., 2017). Many students engage in procrastination, both in completing course assignments and in the final stages of completing capstone projects or theses (Saman, 2017). Academic procrastination, often referred to as academic delay, is typically a conscious act by students (Karlina et al., 2023). Students are aware of their procrastination yet continue, believing they can complete the tasks later or assuming there is still plenty of time, despite universities setting specific study duration limits, particularly for undergraduate programs (Dwi & Astuti, 2020).

According to Permendikbud No. 49 of 2014, students are eligible for thesis defence upon completion of a minimum of 144 credits. Undergraduate students have eight years to complete their studies, with on-time graduation achieved at the end of eight semesters (Kurniadi et al., 2022). Undergraduate completion is marked by the successful writing of a thesis or the publication of a reputable journal article.

Multiple factors contribute to students' academic procrastination, stemming from both internal and external sources. Internal factors include low motivation and interest, laziness, low self-confidence (Jarum & Ayudiari, 2022), lack of focus and concentration, fear of failure (Shankar et al., 2017), perfectionism, poor time management (Dwi & Astuti, 2020), preference for enjoyable activities, smartphone addiction, poor self-regulation, among others (Nafeesa, 2018). External factors encompass difficulties in accessing literature, limited resources, the burden of additional assignments and activities, distractions (Faozi & Muslikah, 2022), non-conducive environments, low social support, pressure from parents or professors, and others (Sari & Kusumaningrum, 2022).

Procrastination negatively impacts students by reducing the quality of academic work, creating a sense of personal inadequacy, lowering productivity, missing opportunities, increasing stress, and adversely affecting their overall psychological well-being. According to Ferrari, key aspects of academic procrastination include delaying task initiation and completion, frequent lateness, a gap between planning and actual performance, and engagement in more enjoyable activities (Ferrari et al., 1995).

In a preliminary study conducted in January 2024 with 113 students who reported experiencing procrastination, 70.3% of students used their smartphones primarily to scroll social media, 38% had daily smartphone use exceeding 7 hours, 71% viewed smartphones as a source of entertainment, 54.2% frequently checked notifications, 35% acknowledged delays in completing their final projects due to smartphone use, and 66.9% reported sleeping less than 8 hours a night. This preliminary study reveals a high level of smartphone addiction among final-year students who exhibit procrastination behaviors.

Smartphone addiction and academic procrastination

One of the factors contributing to academic procrastination in the digital era is smartphone addiction. Smartphones have become widely used across various demographics, with university students being among the largest user groups. According to data from KOMINFO, the age group with the highest smartphone usage is 20–29 years old, accounting for 75.95% of users, which predominantly includes undergraduate students, (Leski Rizkinaswara, 2019). Social media usage is also highest among individuals with Diploma or undergraduate education, reaching 97.55%, (Putri & Nuraini, 2023). In terms of education level, 93.02% of individuals with a Diploma or undergraduate education use smartphones for 1–3 hours daily, (Suhadianto & Pratitis, 2020). Similarly, data from KOMINFO the highest internet usage by age group is also among those aged 20–29 years, at 60.15%, (Bakri, 2021). These findings indicate that university students are the most frequent smartphone users, and this dependency may contribute to academic procrastination (Tamala et al., 2024).

Previous studies have shown a positive correlation between smartphone addiction and academic procrastination. Students addicted to smartphones are more likely to delay their academic tasks (Kwon et al., 2013; Li et al., 2020; Liu, 2023; Leung & Liang, 2016). For example, a study on Chinese university students found a significant positive relationship between smartphone addiction and academic procrastination (Li et al., 2020). Research by Novalyne and Soetjiningsih (2022) also revealed a positive and significant relationship between smartphone addiction and academic procrastination. Similarly, Adca et al. (2023) observed that the higher a student's level of smartphone addiction, the greater their academic procrastination, and vice versa. Sitorus (2022) found that lower levels of smartphone addiction were associated with lower levels of procrastination.

Smartphone addiction has also been linked to negative effects beyond academic procrastination, including psychological well-being. Zhao et al. (2024) and Rozgonjuk et al. (2018) reported that smartphone addiction negatively impacts academic achievement, study dedication, learning performance, and interpersonal relationships among students. Furthermore, academic procrastination and school burnout can exacerbate the negative effects of smartphone addiction on psychological well-being (Zhao et al., 2024).

Gender and educational level differences in academic procrastination have been observed in prior research, with male and undergraduate students displaying higher levels of procrastination (Liu, 2023). Academic self-efficacy, defined as the belief in one's ability to complete academic tasks, serves as a mediator in this relationship. Poor time management and ineffective learning strategies have also been identified as mediators linking smartphone addiction to academic procrastination. Students addicted to smartphones often exhibit poor time management and suboptimal learning strategies, which contribute to increased procrastination (Leung & Liang, 2016).

Psychological factors, including time management, learning strategies, academic self-efficacy, social anxiety, and self-regulation, play significant roles in the relationship between smartphone addiction and academic procrastination (Tian et al., 2021; Xiong et al., 2024). Self-regulation in learning has been found to negatively correlate with both academic procrastination and smartphone addiction, highlighting its critical role in mitigating these behaviors (Sheinov et al., 2024).

Self-regulated learning as mediator for smartphone addiction

Self-regulated learning (SRL) encompasses the ability to set goals, monitor progress, and manage one's learning processes (Zimmerman, 1989; Bloom, 2013). SRL involves time management, learning strategy approaches, self-efficacy for self-directed learning, and effort regulation (Liu et al., 2022; Teng, 2022; Toharudin et al., 2019). Prior research indicates a negative correlation between SRL and academic procrastination, demonstrating that effective self-regulation can reduce the tendency to procrastinate (Núñez et al., 2011; San et al., 2016).

Concerning smartphone addiction, previous studies reveal a positive relationship between smartphone addiction and academic procrastination (Li et al., 2020; Chen & Lyu, 2024). Excessive smartphone use can lead to negative outcomes, such as academic procrastination, and indirectly affect student anxiety levels (Xiong et al., 2024). Nevertheless, prior studies suggest that academic self-efficacy, an SRL component, acts as a buffer between smartphone addiction and academic procrastination, highlighting its potential to mitigate the impact of smartphone addiction on procrastination (Fathi et al., 2015; Li et al., 2020). Effort regulation, a learning strategy linked to SRL, has also been found to predict variations in academic procrastination, suggesting that enhancing this

SRL aspect could help reduce procrastination tendencies (Martinie et al., 2023).

Interventions focused on improving time management and strengthening learning strategy approaches have been recommended to decrease academic procrastination among students (Liu et al., 2022). Teaching strategies to reduce procrastination has proven effective in lowering academic procrastination and enhancing specific SRL processes, such as time management and concentration (Toharudin et al., 2019).

These findings underscore the complexity of the relationship between smartphone addiction, SRL, and academic procrastination. While smartphone addiction has been positively associated with academic procrastination, certain SRL components, such as time management and strategic learning approaches, are identified as potential mediators in this relationship. Interventions targeting these SRL components may offer promising strategies to reduce the impact of smartphone addiction on academic procrastination.

The gap of knowledge

Extensive research has been conducted to identify factors influencing academic procrastination, including self-concept (Damarhadi et al., 2020), internet use (Tezer et al., 2020), social media addiction (Suárez-Perdomo et al., 2022), self-regulation (Pellokila & Taneo, 2023), academic stress, and smartphone addiction (Bakri, 2021; Pertiwi, 2020). However, prior studies have primarily focused on direct relationships between pairs of variables, such as smartphone addiction and academic procrastination, or regular study habits and procrastination. Few studies, however, have taken a comprehensive view of how smartphone addiction and academic procrastination interact through mediators like self-regulated learning. Furthermore, while quantitative methods, particularly SEM analysis, are commonly used, the integration of these specific variables within a cohesive model remains underexplored in the context of the student population at the study's university. Thus, it is not yet fully understood whether similar findings apply to different populations or cultural contexts.

The novelty of this research lies in its approach to modeling the relationships between smartphone addiction, academic procrastination, and self-regulated learning within a unified framework. Utilizing

SEM, this study provides a more holistic perspective on how self-regulated learning mediates the relationship between smartphone addiction and academic procrastination. Additionally, this research offers new insights into the dynamics of these variables within the context of the university's student population, who may exhibit distinct smartphone use patterns and academic cultures compared to similar studies conducted in other countries. This integrated model provides a fresh perspective on developing interventions aimed at reducing academic procrastination and enhancing regulated learning through better management of smartphone addiction.

Method

Design

This study employs a quantitative method with a correlational design, testing the model using Structural Equation Modeling (SEM) with AMOS version 26. The aim of this research is to examine the impact of smartphone addiction on academic procrastination, with self-regulated learning as a mediating variable.

Participants

The population in this study consists of final-year students from the 2017–2019 cohorts who exhibit procrastination behaviors. A sample of 304 students was selected using purposive sampling with specific criteria: active final-year students at University X from the 2017–2019 cohorts who have not completed their final projects and who procrastinate on account of smartphone use for 5–8 hours daily.

Measurement

The instruments used in this study consist of three scales, each demonstrating high reliability and containing items relevant to the measured variables. Content validity was established through expert judgment, and internal consistency was estimated using Cronbach's alpha.

The Smartphone Addiction Scale developed by Viviyanti (2019), comprises 33 items, with a tryout yielding an alpha reliability coefficient of 0.963. While the original sample consisted of adolescents, this study focuses on final-year students. The scale uses a 5-point Likert response format (strongly agree, agree, somewhat agree, disagree, strongly disagree). Sample items include statements like: "I find it hard

to concentrate on my thesis because I want to use my smartphone immediately," "I feel sleep-deprived due to excessive smartphone use," and "I feel annoyed when interrupted while using my smartphone."

The Self-Regulated Learning Scale, developed by Nurhikmah (2021), initially comprised 49 items, with a tryout yielding 47 valid items and an alpha reliability coefficient of 0.956. The previous study involved middle and high school students, while this study focuses on final-year students who have not completed their thesis work within eight semesters. This scale also uses a 5-point Likert response format. Example items include: "I note important points during revisions to improve understanding," "I eliminate distractions while working on my thesis," and "I have no designated time for thesis work."

The Academic Procrastination Scale developed by Nurajawati (2023), includes 25 items, with a tryout yielding 23 valid items and an alpha reliability coefficient of 0.928. The original study involved students from a single program, whereas this study includes students across multiple programs from eight faculties. This scale also employs a 5-point Likert response format. Sample items include: "I feel reluctant to start working on my thesis," "I feel there is plenty of time to complete my thesis," and "I am unsure how to begin my thesis."

Data Analysis

The SEM analysis was conducted using AMOS, with both measurement model testing and structural model testing (Amin et al., 2023). The measurement model assessment included standardized loading factor (SLF), construct reliability (CR), and average variance extracted (AVE). The structural model testing was performed to examine the hypotheses, evaluating both direct and indirect (mediated) effects.

Result

Before testing the SEM model, the data were first categorized to identify the intervals within which the research sample groups fall. The analysis is presented in the following table.

Table 1

Sample Categorization Based on Interval

Academic procrastination			
Interval	Category	Frequency	%
Very High	>76	40	13.1
High	60,8-75,9	112	36.8
Moderate	45,6-60,7	73	24.0
Low	30,4-45,5	53	17.4
Very Low	≤ 30,3	26	8.5
	Self-regulated Learning		
Very High	≥ 136	47	15.4
High	108.8 - 135.9	6	1.9
Moderate	81.6 - 108.7	66	21.7
Low	54.4 - 81.5	117	38.4
Very Low	≤ 54.3	68	22.3
	Smartphone Addiction		
Very High	≥ 96	75	24.6
High	76.8 - 95.9	124	40.7
Moderate	57.6 - 76.7	47	15.4
Low	38.4 - 57.5	46	15.1
Very Low	≤ 38.3	12	3.94

Sumber: SPSS versi 26 dan Microsoft Excell

Based on the categorization in the table above, it was found that academic procrastination among final-year students falls into the high category, with a total of 112 students. Smartphone addiction in this study is also categorized as high, involving 124 students. However, self-regulated learning in this study falls into the low category. After grouping the sample based on intervals, a measurement model analysis of the variables was conducted using the Confirmatory Factor Analysis (CFA) technique. The criteria applied include an SLF value > 0.5, a CR value > 0.7, and an AVE value > 0.5. The analysis is presented as follows.

Table 2

Results of SLF, CR, and AVE Values

Variables	SLF	CR	AVE
Academic procrastination	>0,5	0,965	0,602
Self-regulated learning	>0,5	0,983	0,616
Smartphone addiction	>0,5	0,974	0,631

Based on the results of the CFA, as shown in the table above, the AVE values for each variable and the combined measures are > 0.5. The CR value for the academic procrastination variable is 0.965, for the self-regulated learning variable is 0.983, and for the smartphone addiction variable is 0.974. The AVE for the academic procrastination variable is 0.602, for the self-regulated learning variable is 0.616, and for the smartphone addiction variable is 0.631. Therefore, it can be concluded that the AVE values for each variable are > 0.7, and the AVE for each individual variable is > 0.5. Following the CFA analysis, the next step is to conduct an overall model fit test. The details are as follows.

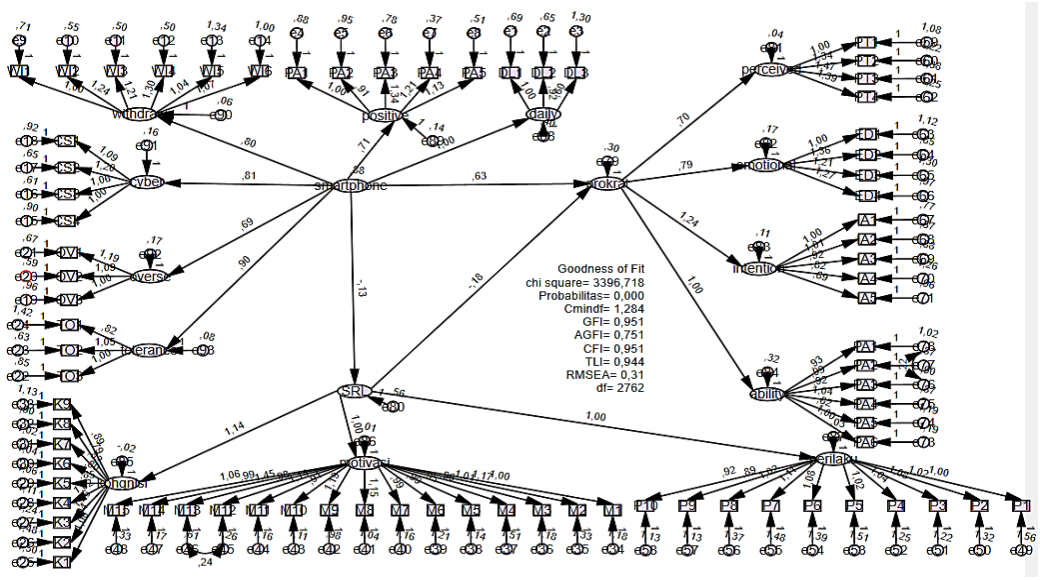

Figure I. Results of the overall model test

Table 3
Goodness of Fit Results for the Model

Goodness of Fit Index	Cutt Off Value	Result	Conclusion
X^2 *Chi Square* (df= 2762, p = 0,05)	< 341,395	3396,718	Not Fit
Sig. Probability	≥ 0,05	0,000	Not Fit
df	≥ 0	2762	Fit
RMSEA	≤ 0,08	0,31	Not Fit
GFI	≥ 0,90	0,786	Marginal Fit
AGFI	≥ 0,90	0,751	Marginal Fit
CMIN/DF	≤ 2,00	1,284	Fit
TLI	≥ 0,90	0,944	Fit
CFI	≥ 0,90	0,951	Fit

Based on the goodness-of-fit results above, five indicators met the cut-off value, two indicators showed marginal fit (close to fit), and two indicators did not meet the fit criteria, as they deviated significantly from the cut-off standard. According to Hair (2014), if four criteria achieve goodness-of-fit, the model is considered acceptable. Following this, a structural test was conducted to determine whether the data demonstrated adequate significance; the explanation is provided below.

Table 4
Results of Structural Model Testing and Significance Test

			Estimate	S.E.	C.R.	P	R-Square
SRL	<---	Phone	-,130	,051	-2,534	,017	0,470
prokras	<---	Phone	,634	,077	8,231	***	0,488
prokras	<---	SRL	-,183	,056	-3,252	,001	

The analysis presented in the table 5 indicates that smartphone addiction negatively impacts self-regulated learning, with a path coefficient of -0.130 and a significant p-value of 0.17 < 0.05. The R-square value for self-regulated learning is 0.470, which implies that smartphone addiction accounts for 47% of the variance in self-regulated learning. Additionally, smartphone addiction positively affects academic procrastination with a path coefficient of 0.634 and a significant p-value of 0 < 0.05. Self-regulated learning negatively affects academic procrastination with a path coefficient of -0.183 and a significant p-value of 0.001, also less than 0.05. The R-square value for academic procrastination is

0.488, indicating that smartphone addiction and self-regulated learning together account for 48% of the variance in academic procrastination.

To further explore mediation, a Sobel test was conducted to assess whether self-regulated learning mediates the effect of smartphone addiction on academic procrastination, as per the proposed model. The Sobel test result, shown in the figure above, demonstrates that self-regulated learning mediates the influence of smartphone addiction on academic procrastination, with a Sobel test statistic of 2.009 > 1.96 and a p-value of 0.04 < 0.05, confirming the mediation hypothesis. Thus, it can be concluded that self-regulated learning acts as a mediator between smartphone addiction and academic procrastination. A summary of the hypothesis testing results for this study is presented below. The findings support that this study uses a partial mediation model, where smartphone addiction influences academic procrastination both directly and indirectly via self-regulated learning.

Discussion

The hypothesis testing results show that self-regulated learning significantly mediates the influence of smartphone addiction on academic procrastination among final-year students at University X. In other words, self-regulated learning acts as an intermediary variable between smartphone addiction and academic procrastination, as indicated by the Sobel test statistic of 2.009 > 1.96 and P = 0.04. The R-square for academic procrastination is 48.8%, meaning 51.2% of the variance is attributed to other variables not investigated in this study.

The mediation effect in this study is stronger than the direct effect of smartphone addiction (X) on academic procrastination (Y). Self-regulated learning serves as a mediator, as evidenced by the model testing results, where the direct effect of X on Y is 0.63, and the indirect effect of X on Y via M yields a total effect of 0.63 + 0.023 = 0.6534. The relationship between smartphone addiction and self-regulated learning is negative, and self-regulated learning negatively impacts procrastination. This suggests that the correlations and effects between variables are not aligned; self-regulated learning acts as a self-regulatory mechanism that mitigates the procrastination triggered by smartphone addiction, preventing delays in thesis completion.

This finding aligns with theories stating that smartphone addiction can contribute to procrastination behavior through disruptions in self-regulated learning, (Cho et al., 2017). (Steel, 2007) emphasizes that this theory focuses on psychological and situational factors influencing procrastination, with self-regulated learning potentially acting as a mediator (Hwang & Oh, 2021; Wu et al., 2022; Zhang et al., 2023), including in the relationship between smartphone addiction and procrastination. For students experiencing smartphone addiction, which delays task completion, self-regulated learning may provide a solution. Conversely, students with low self-regulated learning who are addicted to smartphones may be more likely to procrastinate.

Descriptive test results indicate that 112 students fall into the high procrastination category, with a rate of 36.8%. This aligns with field observations that final-year students at University X (2017-2019 cohorts) who have not completed their final assignments intentionally procrastinate. Interviews suggest that while these students are aware of deadlines for thesis or journal submission, they believe they can delay the work until tomorrow or later.

Some respondents mentioned that online learning increased their tendency to procrastinate on final assignments, exacerbated by both internal and external factors, such as smartphone addiction, which leads to time spent gaming, watching videos, and even gambling, ultimately hindering academic progress. Other factors include lack of familiarity with thesis formatting, limited access to supervisors, difficulty finding references, interruption at the revision stage, work commitments, marriage, etc. The highest indicator of academic procrastination is emotional distress (58.12%), consisting of four items. This supports findings by Zainah (2019), which suggest students frequently experience significant emotional symptoms, such as anxiety, sadness, and fear of criticism, negatively affecting self-perception and motivation. Stress related to final assignments can lead to avoidance behaviors, social media complaints, and procrastination (Amin et al., 2023).

Among final-year students, 117 individuals (38.4%) exhibit low self-regulated learning, revealing a deficiency in self-regulation that leads to academic procrastination. Field observations suggest that low self-regulation among these students results in neglect of their final assignments. Students with strong self-regulation skills are less likely to let obstacles during their thesis process prevent them

from completing their work. Motivation emerged as the highest indicator of self-regulated learning, with 59.5%. Field observations confirm that final-year students often lack both internal and external motivation. Many students indicated that inquiries about graduation timelines from others do not inspire them to finish; instead, they feel pressured, leading to increased anxiety and fear. Many students do not prioritize thesis work, and intrinsic motivation to complete the task is low. They do not have a regular time set aside for working on their thesis (Ichsan et al., 2023).

The study reveals that smartphone addiction is high among respondents, with 124 students (40.7%) indicating significant smartphone use, which contributes to procrastination. Smartphones are often used for activities other than research and do not facilitate thesis completion. The most significant factor in smartphone addiction is positive anticipation; final-year students acknowledge the need to prevent excessive smartphone use but continue to do so despite their awareness. This aligns with findings by Palupi et al. (2018), who suggest that smartphones can disrupt students' ability to manage emotions and expectations, impacting positive anticipation among final-year students. Additionally, smartphone addiction is associated with academic delays, negatively affecting time management and strategic learning approaches. Maintaining a positive outlook on responsibilities and future goals is crucial (Muflih et al., 2021).

Smartphone addiction has been identified as a significant factor affecting procrastination, with research showing self-regulated learning's mediating role in this relationship (Albursan et al., 2022). Similarly, Saad & Gamal Khalifa (2020) found that self-regulated learning negatively correlates with procrastination and smartphone addiction. Additionally, Rahmi & Safitri (2023) show that self-regulated learning fully mediates the relationship between psychological capital and academic delay. Collectively, these findings suggest that smartphone addiction may lead to academic procrastination, with self-regulated learning playing a crucial role in mediating this relationship. Individuals with poor self-regulation skills may be more prone to smartphone addiction, which, in turn, exacerbates delays in completing final assignments. Enhancing self-regulated learning skills could potentially reduce the impact of smartphone addiction on academic procrastination.

Conclusion

This study concludes that smartphone addiction influences academic procrastination among final-year students, with self-regulated learning mediating this effect. Higher levels of smartphone addiction among final-year students are associated with increased procrastination in completing final assignments. Conversely, lower levels of smartphone addiction lead to lower rates of academic procrastination. Improved self-regulated learning among final-year students may reduce smartphone addiction, thereby mitigating academic procrastination.

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Conflict of Interest
The researchers declare that this paper has no conflicts of interest.

Author Contribution
All authors have contributed equally to the study's conceptualization, interpreting data, reviewing, and editing the manuscript.

Data Availability
Data can be provided upon request to the author.

Declarations Ethical Statement
The study followed the guidelines of the Declaration of Helsinki.

Informed Consent Statement
Informed consent was obtained from all persons involved in the study.

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