ORIGINAL RESEARCH

The Mediating Roles of Time Management and Learning Strategic Approach in the Relationship Between Smartphone Addiction and Academic Procrastination

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Purpose: Smartphone is an indispensable everyday tool for college students, while excessive usage of smartphones may lead to negative outcomes, such as academic procrastination. Previous research has suggested that smartphone addiction is a predisposing factor for procrastination. To further understand the above relationship, structural equation model analysis was used to examine the mediating effects of time management and learning strategic approach in the association with smartphone addiction and academic procrastination.

Materials and Methods: A cross-sectional study was conducted in September 2021. A total of 1129 college students aged 18 to 22 participated in the present study was adopted the cluster random sampling method and the following tools were used: the Mobile Phone Addiction Index Scale, Time Management Disposition Scale, Revised Approaches to Studying Inventory, and Aitken Procrastination Scale.

Results: Results indicated that smartphone addiction is positively linked to academic procrastination, while negatively linked to time management and learning strategic approach. Both time management and learning strategic approach were negatively linked to academic procrastination. Additionally, the results showed that time management and learning strategic approach serve sequential mediating roles in the association with smartphone addiction and academic procrastination among Chinese college students after controlling for age and sex (RMSEA = 0.045, SRMR = 0.035, TLI = 0.993, CFI = 0.979).

Conclusion: Time management and learning strategic approach serve sequential mediating roles in the association with smartphone addiction and academic procrastination among Chinese college students. Therefore, intervention management that focusing on improving time management as well as strengthening learning strategic approach may be useful for reducing academic procrastination among college students.

Keywords: smartphone addiction, academic procrastination, time management, learning strategic approach

Introduction

Smartphones have infiltrated virtually every aspect of modern life because of their convenience, interaction, and portability.[1] The 48th Statistical Report on China's Internet Development Status showed that the number of smartphone users in China has reached one billion.[2] Smartphone overuse can lead to problematic smartphone usage or smartphone addiction.[3] Smartphone addiction is a new type of behavioral addiction in which "individuals spend most of their time scrolling, watching, liking, commenting, stalking and talking to their friends through different mobile applications".[1] Considering the high prevalence of smartphone addiction among college students, many researchers and educators have focused on the relationship between smartphone addiction and college students' academic problems, such as academic

procrastination.[1,4] Procrastination is the voluntary postponement of beginning with or completing a planned behavior despite the foreseeable negative consequences of postponing the behavior.[5] In a study on Chinese college students, Lian found that smartphone overuse was positively related to academic procrastination after controlling for sex, age, and year of study.[4] However, little research has been conducted into the specific processes of the link between smartphone addiction and academic procrastination in learning contexts.

Self-regulation learning theory suggests that the processes through which students take an active, purposeful role in managing their own studying, learning, or academic engagement, such as effective time management and positive learning approach strategies, lead to increased academic achievement, while ineffective self-regulation strategies may be linked to negative academic performance.[6–8] In a survey, researchers found that effective time management was inversely associated with academic procrastination.[9] It is difficult for students to learn to learn to self-regulate. College students spend several hours on smartphones every day, which harms students' ability to self-regulate. Empirical evidence suggests that dysfunctional social media use may lead to procrastination.[4,10] Neuroimaging studies have also found that addictive behaviors can damage the prefrontal cortex and further impair higher cognitive function (ie, self-regulation).[11] Therefore, based on self-regulation learning theory, the current study aimed to test the relationship between smartphone addiction and academic procrastination, and also to explore the roles of time management and learning strategies in the above relationship.

Time Management as a Mediator

Time management refers to individuals' monitoring and control of the use of their time.[12] According to self-regulation learning theory, time management is a positive form of self-regulation, while procrastination reflects poor self-regulation.[8,13] Time management is frequently related to individuals' academic performance.[9,14] Specifically, effective time management is positively related to strategic learning and academic achievement. However, poor time management practices, such as improperly allocating time for learning assignments and failing to meet deadlines, are frequently related to poor academic performance and academic procrastination.[9] Moreover, in an experimental intervention study, the time management training intervention group with effective self-regulatory skills showed less procrastination than the control group among undergraduate students of a medium-sized German university.[14]

In addition, a previous study also showed that time management was related to addictive behavior.[15] In a college sample researchers found that smartphone addiction was negatively related to time management.[16] According to the metacognitive model of addictive behaviors, metacognition plays an important role in technological addictions, and metacognitive beliefs are related to addictive behaviors.[3] Empirical studies have shown a significant relationship between metacognitive beliefs and smartphone addiction.[3,17] In other words, time management, as a kind of metacognitive strategy, is closely related to addictive behaviors.[18]

Learning Strategic Approach as a Mediator

Strategic learning approaches involve students' intentions to do well in their studies, students' self-regulation as it relates to their studying, and their awareness of learning in their context.[19] A strategic learning approach was considered a positive form of self-regulation, while procrastination was associated with low self-control and poor self-regulation.[7] Researchers examining procrastination within a self-regulated learning framework have found that using an effective learning strategy is negatively associated with academic procrastination.[13] In addition, though some studies have shown that problematic smartphone use is associated with deep and surface level approaches to learning,[20,21] whether smartphone addiction is related to utilizing a strategic learning approach has not been explored. Therefore, given the adverse effects of smartphone addiction on individuals' procrastination, and the influence of a strategic learning approach, strategic learning approaches mediate the relationship between smartphone addiction and academic procrastination.

Mediating Roles of Time Management and Learning Strategic Approach

As per self-regulation learning theory, time management and strategic learning approaches are positive forms of self-regulation that help manage one's learning.[8] Meanwhile, procrastination reflects a negative form of self-regulation and it is negatively related to time management and strategic learning approaches.[13] Compared to non-procrastinators, procrastinators are less likely to adopt a systematic and disciplined approach to their work, and are less likely to adopt effective strategies

that demand effort and time to develop.[7] As previously discussed, smartphone addiction among college students leads to poor time management and inefficient learning strategies.[20] Therefore, the present study proposes that time management and a strategic learning approach mediate the association between smartphone addiction and academic procrastination. In addition, indirect evidence shows that a sequential mediating effect of time management and strategic learning approaches may exist between smartphone addiction and procrastination.[22] An investigation of the relationship between metacognitive processes and strategy selection indicates that metacognitive processes could be involved in the early strategy selection processes, when participants try to select the best strategy for the relevant problem.[22] Therefore, based on previous studies, a multiple mediation model could be expected among these variables, as this study proposes. Specifically, college students with a high level of smartphone addiction will likely have poor time management, which further reduces the use of strategic learning approaches, increasing the likelihood of academic procrastination.

The Current Study

College students are usually undergoing a critical period of their learning and growth, and they are generally no longer subject to strict discipline or supervision by parents and/or teachers. Therefore, they are more likely to develop smartphone addiction. According to media dependency theory, excessive reliance on smartphones among college students leads to academic procrastination.[1]

Therefore, the current study used a multiple mediation model to examine whether time management and strategic learning approaches are potential mediators of smartphone addiction and academic procrastination among Chinese college students. We propose the following hypotheses

Hypothesis 1: smartphone addiction is positively related to academic procrastination in college students

Hypothesis 2: Smartphone addiction has an indirect effect on college students' academic procrastination via time management

Hypothesis 3. strategic learning approach is a mediator in the relationship between smartphone addiction and college students' academic procrastination

Hypothesis 4: time management and strategic learning approaches serve sequential mediating roles between smartphone addiction and academic procrastination.

Specifically, smartphone addiction is negatively related to time management, and negatively related to the use of a strategic learning approach, which increases the prevalence of academic procrastination. The proposed model is illustrated in Figure 1.
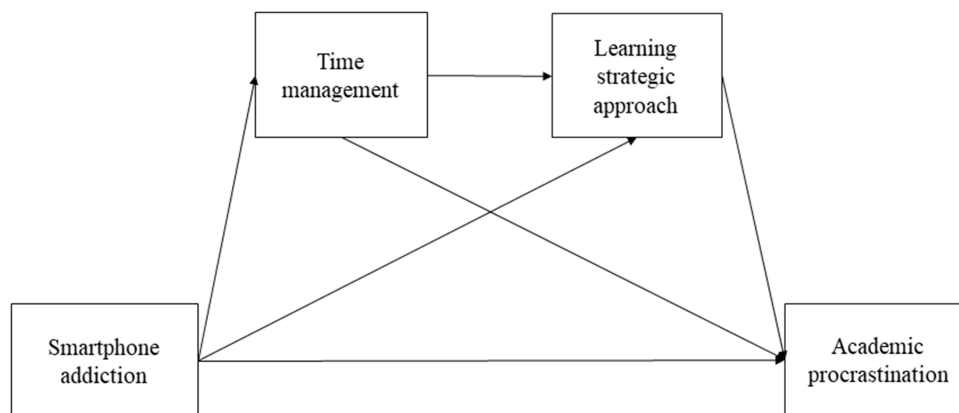

Figure 1 The conceptual multiple mediation model.

Materials and Methods

Participants

In September 2021, a cross-sectional study was conducted using a cluster random sampling method with participants from three universities in Liaoning Province. Researchers and school classroom teachers cooperated in issuing questionnaires to the participants in classroom settings. All participants provided informed consent and spent approximately 15 minutes completing each questionnaire item. After excluding invalid questionnaires (the response rate was below 30%), 1129 questionnaires were collected. Of the responses, 635 (56.2%) were from boys and 494 (43.8%) girls. The ages of the participants ranged from 18 to 22 years old, with an average age of 19.82 (SD = 1.14). Of the 1129 participants, 257 (22.8%) were freshmen, 293 (26.0%) were sophomores, 318 (28.2%) were juniors, and 261 (23.1%) were seniors. The study was conducted in compliance with the Declaration of Helsinki and was approved by the Human Research Ethics Committee of University of Science and Technology Liaoning. Table 1 presents the demographic profiles of the participants.

Measures

Smartphone Addiction

The Mobile Phone Addiction Index Scale was adopted to measure smartphone addiction among Chinese college students.[23] The scale consists of 17 items, which include four dimensions: inability to control craving (7 items, for example, "Your friends and family complained about your use of the mobile phone"), withdrawal/escape (3 items, for example, "You have used your mobile phone to talk to others when you were feeling isolated"), feeling anxious and lost (4 items, for example, "When out of range for some time, you become preoccupied with the thought of missing a call") and productivity loss (3 items, for example, "Your productivity has decreased as a direct result of the time you spend on the mobile phone"). Participants answered the items on a five-point Likert scale (1 = never, 5 = always). A previous study has shown the satisfactory validity and reliability of scale among Chinese college students.[4] In the current study, Cronbach's α was 0.86, while those of the four dimensions constituting the scale were 0.76, 0.71, 0.79, and 0.71, respectively.

Time Management

Time management was assessed using the Time Management Disposition Scale compiled for Chinese adolescents by Huang.[12] This scale consists of 44 items that include three dimensions: time value (10 items, for example, "I believe that time is life."), time control (24 items, for example, "I usually organize my daily activities into a schedule"), time efficacy

Table 1 The Demographic Profiles of Participants (N = 1129)

Variable	Levels	Frequency	Percentage
Sex	Male	635	56.2%
	Female	494	43.8%
Age	18	143	12.7%
	19	324	28.7%
	20	355	31.4%
	21	209	18.5%
	22	98	8.7%
Year of study	Freshmen	257	22.8%
	Sophomores	293	26.0%
	Juniors	318	28.2%
	Seniors	261	23.1%
Urban/Rural area	Urban	453	40.3%
	Rural	671	59.7%
	Missing	5	
Major	Engineering	679	60.6%
	Art	308	27.5%
	Science	132	11.8%
	Missing	8	

(10 items, for example, "I can use my time efficiently."). The subscale showed satisfactory validity and reliability among Chinese students.[9] In the present study, Cronbach's α for the scale was 0.90, while those of the three dimensions constituting the scale were 0.74, 0.86, and 0.72, respectively.

Learning Strategic Approach
College students' learning strategic approach was adapted to the Revised Approaches to Studying Inventory subscale.[24] The sample item was "I organize my study time carefully to make the best use of it". The scale showed satisfactory validity and reliability in previous studies.[21] Considering that this scale was an English scale, we performed a back-translation method of the English scale to make it understandable to Chinese participants. First, the original scale was strictly translated by two Chinese psychologists and then the draft was modified and compared by a bilingual psychologist. Second, the Chinese version was translated into English by a bilingual psychologist, and the inconsistencies were discussed and modified to ensure that the items of the scale were easy to understand, and a final version of the scale was determined. In this study, the Cronbach's α for the scale was 0.75.

Academic Procrastination
Academic procrastination was assessed using the Aitken Procrastination Scale, which is a single-dimension self-rating scale with a total of 19 items.[25] We adopted the Chinese version of the scale as translated by Chen.[26] Participants answered the items on a five-point Likert scale (1 = completely inconsistent, 5 = fully consistent). A sample item was "I delay starting things until the last minute". The scale showed satisfactory validity and reliability in Chinese samples.[26] In this study, the Cronbach's α of the scale was 0.84.

Statistical Processing and Analysis Plan
Data were analyzed using SPSS 25.0, and Mplus 8.3. First, descriptive statistics and correlational analyses were performed for all variables using SPSS 25.0. Second, the relationships in the research model were analyzed using structural equation modeling with Mplus 8.3. Structural equation modeling was performed using the maximum likelihood estimation, which requires continuous data and multivariate normality. Maximum likelihood estimation is virtually always utilized in such instances.[27] To examine whether the data fit the theory, the following fit indices were used: comparative fit index (CFI), Tucker-Lewis index (TLI), root-mean-square error of approximation (RMSEA), and standardized root mean square residual (SRMR). Finally, the bootstrap method was used to test confidence intervals. The impact of variables as mediators were investigated using bias-corrected bootstrapping with 2000 bootstrap samples at a 95% confidence interval. Bootstrapping is a resampling approach in which a large number of sub-samples of the same size as the original sample are selected at random for empirical parameter estimation and the exploration of fit indices.[28] Thus, we employ the bootstrapping technique to evaluate the direct and indirect impact of the variables.

Results
Descriptive Statistics and Correlational Analyses
Table 2 shows the mean value, standard deviation, and correlation coefficient of each variable. We used the Pearson Product Moment Correlation Coefficient to determine the relationships between variables and used the *t*-test of significance of r to

Table 2 Descriptive Statistics and Correlations Among Variables (N= 1129)

	M	**SD**	**1**	**2**	**3**	**4**	**5**
1 Sex	–	–	–				
2 Age	19.82	1.14	0.06*	–			
3 Smartphone addiction	2.69	0.70	−0.00	−0.03	–		
4 Time management	10.08	1.36	0.04	0.11**	−0.11**	–	
5 Learning strategic approach	3.21	0.56	0.02	0.10**	−0.19***	0.69***	–
6 Academic procrastination	2.58	0.55	0.01	−0.08**	0.40***	−0.54***	−0.47***

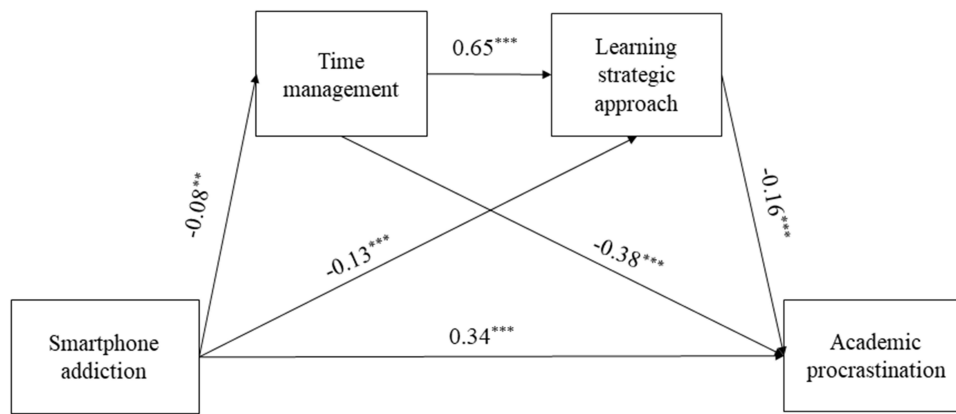**Notes**: *p<0.05, **p<0.01, ***p<0.001, Sex code: 0 = men, 1 = women.

Figure 2 A multiple mediation model for the association between smartphone addiction and academic procrastination.
Note: **$p<0.01$, ***$p<0.001$.

further test the strength of the correlation. The analyses showed that smartphone addiction was negatively correlated with time management ($r = -0.11$, $p < 0.001$) and learning strategic approach ($r = -0.19$, $p < 0.001$), and positively correlated with academic procrastination ($r = 0.40$, $p < 0.001$). Meanwhile, there was a significant positive correlation between time management and learning strategic approach ($r = 0.69$, $p < 0.001$), whereas academic procrastination was negatively correlated with time management ($r = -0.54$, $p < 0.001$) and learning strategic approach ($r = -0.47$, $p < 0.001$).

Testing for the Multiple Mediation Model

Structural equation model analysis was used to examine the mediating effect of time management and a strategic learning approach and the influence of smartphone addiction on academic procrastination. After controlling for age and sex, the proposed model (Figure 2) displayed goodness of fit to the data (χ^2/df = 3.28, TLI = 0.993, CFI = 0.979, RMSEA = 0.045, SRMR = 0.035). Smartphone addiction (standardized coefficients, $\beta = 0.34$, $p < 0.001$) and learning strategic approach ($\beta = -0.16$, $p < 0.001$) were positive predictors of academic procrastination, whereas time management was a negative predictor of academic procrastination ($\beta = -0.38$, $p < 0.001$). Moreover, smartphone addiction was a negative predictor of time management ($\beta = -0.08$, $p < 0.01$) and learning strategic approach ($\beta = -0.13$, $p < 0.001$). In addition, time management significantly predicted learning strategic approach ($\beta = 0.65$, $p < 0.001$). Figure 2 shows the standardized path coefficients of the ultimate model.

The significance of the mediating effects was tested using a bias-corrected bootstrap analysis (see Table 3). The mediating effects of time management are significant (0.031, 95% CI = [0.093, 0.053]). We then examined the mediating effect of the learning strategic approach, the bootstrapping results showed that the mediating effect was 0.021, 95% CI = [0.011, 0.035]. Finally, we examined the mediating effects of time management and learning strategic approach on the

Table 3 The Pathways of the Multiple Mediation Model

Pathways	Standardized Effect	95% CI	
		Lower	Upper
Direct effects			
SA1→AC	0.342	0.293	0.386
Indirect effects			
SA1→TM→AC	0.031	0.009	0.053
SA1→SA2→AC	0.021	0.011	0.035
SA1→TM→SA2→AC	0.008	0.002	0.017
Total indirect effects	0.060	0.031	0.092

Abbreviations: SA1, smartphone addiction; TM, time management; SA2, learning Strategic approach; AC, academic procrastination.

influence of smartphone addiction on academic procrastination, and the bootstrap analysis indicated that the sequential mediating effect was 0.008, 95% CI = [0.031, 0.092]).

Discussion

Academic procrastination is a prevalent phenomenon among college students that frequently results in poor academic performance and mental health.[7] Previous studies have shown that smartphone overuse may be a risk factor for procrastination,[4] impairing an individual's higher-order cognitive function, which is related to academic procrastination.[3] Therefore, based on self-regulation learning perspective, the present study employed a multiple mediation model to explore the causes and possible mechanisms of academic procrastination. The present findings show that smartphone addiction is negatively related to time management, which reduced the usage of learning strategic approach and increased the likelihood of academic procrastination.

Smartphone Addiction and Academic Procrastination

The current findings support Hypothesis 1, which suggests that smartphone addiction is positively related to academic procrastination. The result supports self-regulation learning theory, which suggests that the lack of self-management in smartphone usage leads to poor self-regulation and procrastination.[10] Smartphone addiction leads to an excessive desire to use mobile phones, which in turn leads to poor self-regulation and consequently leads to procrastination. Past empirical studies support these results.[29] Smartphone addiction leads to an excessive desire for mobile phone usage, because of their easy availability and convenience, which reduces individuals' resistance to the temptation of mobile phones and leads to procrastination. In a longitudinal study, Cui found that problematic mobile phone use was associated with bedtime procrastination.[30] The more time individuals spend using their mobile phones, the less time they spend on other activities (such as sleeping), which leads to procrastination.

In addition, the results also support the temporal motivation theory.[7] This theory revealed that people pursue whichever activity offers the most utility; in other words, whether people procrastinate depends on how valuable tasks are to them. Considering the convenience and entertainment smartphones provide, they act as an ideal compensator or distractor for smartphone-addicted students, especially when said students are in stressful academic situations.[4] The entertainment provided by smartphones may decrease the utility of academic tasks, which leads to academic procrastination among college students. In conclusion, previous studies have shown that smartphone addiction is related to students' academic procrastination.[29]

Mediating Role of Time Management

Consistent with Hypothesis 2, we found that time management mediates the relationship between smartphone addiction and academic procrastination. Specifically, college students who tend to be addicted to smartphones have poor time management, which may increase procrastination.[16] The current findings were consistent with previous research.[15] The present findings suggest that college students' time management is related to their academic procrastination, which further supports self-regulation learning theory.[9,14] Procrastinators are not good at self-regulation, so procrastinators find it difficult to concentrate on learning and underestimate the time needed to complete a learning task, which is why they procrastinate. These findings also support those of previous studies.[14,31] For example, in an experimental intervention study, the researchers used a randomized controlled trial with an experimental training group and an active control group. The results showed that the participants in the experimental group allocated their work time more equally and did not exhibit procrastination.[14] Moreover, the findings also support temporal discounting theory, which suggests that the value of a reward decreases the further into the future the reward is, and explains the influence of time on behavioral choices.[31] According to the temporal discounting theory, individuals tend to choose tasks that reward them immediately (such as playing games), while discounting the value of long-term goals (academic performance), leading to academic procrastination.[31]

Smartphone addiction was significantly negatively correlated with time management.[17] Specifically, addictive behaviors may impair college students' time management, which is regarded as a metacognitive strategy. Previous studies support this finding. For example, in a questionnaire study among Chinese college students in Guangzhou, Liao found

that relative to the students worst at managing their time, the students who were better at managing their time got lower scores on the internet addiction scale.[15] People who immerse themselves in the phone may impair their time cognitive system possibly leading them to not manage their time well.

Mediating Role of Learning Strategic Approach

The results indicate that a learning strategic approach is another important mediator between smartphone addiction and academic procrastination, which is consistent with Hypothesis 3. Specifically, smartphone addiction enhances the occurrence of academic procrastination among college students through an increased negative learning strategic approach. The present findings show that a learning strategic approach is related to academic procrastination. These results also support the poor self-regulation involved in procrastination, which suggests that the psychological definition of procrastination is also a form of self-regulatory failure.[26] This means that college students adopt an inefficient strategic approach in the process of self-regulation, which leads to academic procrastination. The results were also consistent with previous findings.[5] For example, Howell and Waston found that academic procrastination was associated with the inappropriate use of learning strategies (ie, inefficient studying approaches).[13]

In addition, based on self-regulation learning perspective, the present results revealed that poor self-regulation regarding smartphone usage is associated with inappropriate learning strategies, which is consistent with previous studies.[20,21] For example, Rozgonjuk found that problematic smartphone use was negatively correlated with a deep approach to learning and positively correlated with a surface level approach to learning.[21] Smartphone overuse by college students results in less deep learning or more surface level learning.

Mediating Roles of Time Management and Learning Strategic Approach

The results also demonstrated that time management could influence college students' learning strategic approach and consequently influence academic procrastination, which supports Hypothesis 4. The findings support self-regulation learning theory, which suggests that students with good self-regulation use effective skills and strategies to conduct and manage learning activities. Based on self-regulation learning perspective, learning strategies are commonly operationalized with measures that capture the use of metacognitive strategies (ie, monitoring).5 For example, researchers that examined procrastination within a self-regulated learning framework found that using an effective learning strategy is negatively associated with academic procrastination.13 Another study showed that time management, as a metacognitive strategy, affected the choice of subsequent strategy selection.22

Limitations and Implications

The current study had several limitations. First, causal relationships cannot be derived from a cross-sectional study. In the future, the causal relationships among the studied variables should be tested in longitudinal or experimental research. Second, considering that the data were collected only through retrospective self-report measures, the participants might have been subjected to memory or social-desirability bias. Therefore, ecological validity should be considered in future studies using tools such as ecological momentary assessment. Third, procrastination is not always related to negative outcomes, and the concept of active procrastination expands upon the scope of traditional procrastination.[5] Future research could explore the positive aspects of procrastination. Fourth, the present study showed that time management influences the learning strategies of college students. However, some studies have shown that metacognition and cognitive strategies influence each other,[18] which can be further explored in future studies.

The findings of the present study highlight the need for interventions directed at reducing academic procrastination. The current findings showed that time management and strategic learning approaches mediated the relationship between smartphone addiction and academic procrastination among college students. Thus, time management and strategic learning approaches could be important targets in subsequent procrastination interventions. Moreover, courses related to time management and learning strategies should be offered in universities. For example, among the most prevalent academic interventions available to university students, institutional support for proper time management is one of the most important.[8] Thus, courses related to organization and effective use of time have an important and powerful impact

in limiting academic procrastination among college students. Additionally, reducing smartphone usage can also be effective in reducing college students' academic procrastination.

Conclusion

Academic procrastination is widespread among the college population and has severe academic consequences. Based on self-regulation learning theory, we proposed a model to explain why and how smartphone addiction, time management, and the strategic learning approaches interact with college students' procrastination in the learning context. We conducted a survey among university students from China, and 1129 questionnaires were collected. The results indicated that college students who were more addicted to their smartphones tended to procrastinate more when completing their academic work. The results of the study also show that the time management and strategic learning approach mediate the relationship between smartphone addiction and academic procrastination. Specifically, smartphone addiction is negatively related to time management and a strategic learning approach, which increases the risk of academic procrastination. Furthermore, time management and strategic learning approaches serve as sequential mediators between smartphone addiction and academic procrastination. Smartphone addiction is negatively related to time management, which decreases the use of a strategic learning approach, thus increasing the prevalence of academic procrastination. The current findings contribute to the theoretical development of this topic by providing a novel explanation for the influence of smartphone addiction on college students' academic procrastination.

Ethical Approval

This study was conducted in accordance with the Declaration of Helsinki, and the study has been reviewed and approved by the ethics committee of University of Science and Technology Liaoning. Informed consent was obtained from all participants before they participated in the study.

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Disclosure

All authors declare that they have no conflicts of interest in relation to this work.

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